VOLUME 38
NUMBER 8

AUGUST, 1951

plating

MATERIALS OF CONSTRUCTION FOR PICKLING

See Contents Page 823

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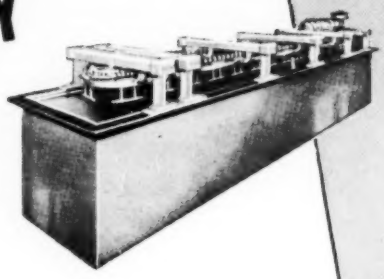

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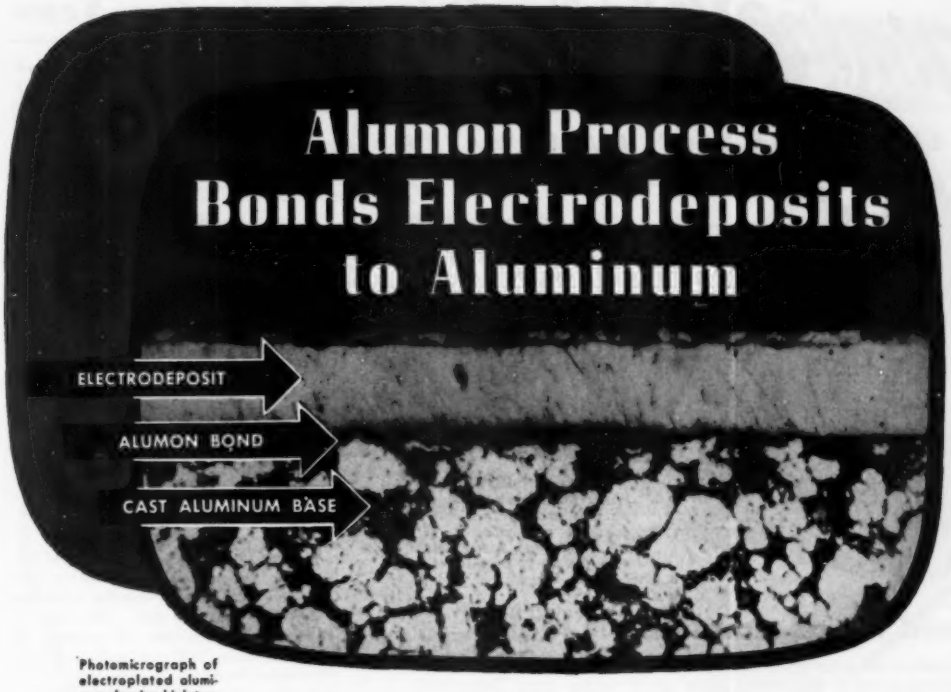
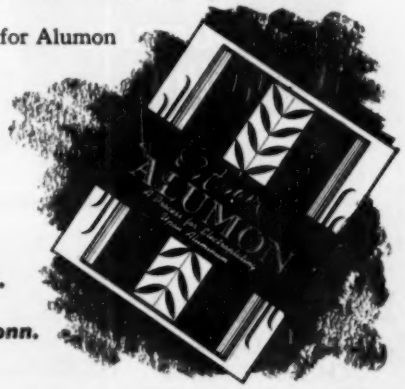
Alumon Process Bonds Electrodeposits to Aluminum



Photomicrograph of electroplated aluminum showing high tensile Alumon Bond.

Hundreds of manufacturers throughout the United States are now using electroplated aluminum. The Alumon process is simple. The work is merely cleaned, dipped in acid, dipped in Alumon and is then ready for electroplating with copper, nickel, and other metals. The process is suitable for plating most wrought and cast alloys . . . The cost of using alumon is low, being less than half a cent per square foot of surface area treated. The process can be fitted easily into regular plating cycles. Write today for Alumon Process bulletin and technical data on how you can use electroplated aluminum for your products.

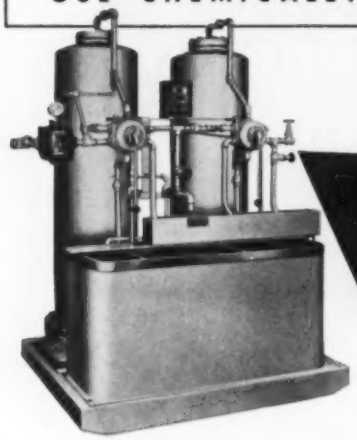


Enthone INC.

442 Elm Street, New Haven, Conn.

Eliminate Hot-Rinse Stains Unwanted Precipitates

USE CHEMICALLY PURE WATER



only a few cents a thousand gallons *with* . . . .

INDUSTRIAL Water Demineralizers

A Two-Bed INDUSTRIAL Water Demineralizer. Standard two- and four-bed units available with capacities of 200 to 1000 gph. Special units of any capacity engineered to requirements.

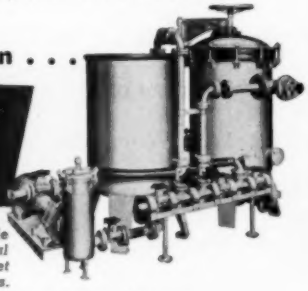
and it's as simple as it looks . . .

besides the extremely low cost, there is nothing complicated about getting the chemically pure water with Industrial Demineralizers. Raw water is passed through either two or four beds of ion-exchange resins and it comes out free of the dissolved mineral salts. No still, heat, steam, or cooling water is needed—keeping space requirements relatively small.

And it's simple to get the complete facts for your case. Send us a water analysis and let us know how much water you have to treat and the gallons per hour needed. We can then give you the whole demineralizer story including estimated costs, equipment required, performance data, etc. for your requirements.

for solution clarification . . .

use an **INDUSTRIAL Filter**



100 to 15,000 gallons per hour. Portable and stationary models. Standard or special filtration systems engineered to meet unusual requirements.

Write for full information and recommendations

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RUBBER DIVISION Vulcanized Linings - Molded Products · WATER DEMINERALIZERS

Industry News

Oakite Establishes Annual Award. John A. Carter, President of Oakite Products, Inc., manufacturers of industrial cleaning and related materials, has announced the establishment by the Company of the David C. Ball Award for Distinguished Service, a bronze plaque to be

presented annually to the member of the Oakite technical field organization who rendered the most outstanding service to industry during the year. The award is designed to perpetuate the memory of David Clifton Ball, pioneer in industrial cleaning procedures, founder of the Company, and Chairman of its Board of Directors at the time of his death in March of this year.

Six Manufacturing Affiliates of the General Electric Company became departments of the parent company on June 30, namely, Carboloy Company, Inc., with headquarters in Detroit; General Electric X-Ray Corporation, Milwaukee; Locke Inc., Baltimore; Telechron, Inc., Ashland, Mass.; Monowatt, Inc., Providence, R. I.; and The Trumbull Electric Manufacturing Company, Plainville, Conn.

Locke, Inc., manufactures ceramic products for electrical apparatus and for chemical and mechanical applications. Telechron, Inc., produces industrial timing devices and synchronous timing motors. The Trumbull Electric Manufacturing Company produces a variety of products in the electrical control field, ranging from open knife switches to panelboards and switchboards.

Enley Products, Inc., 254 Pearl St., New York 38, N. Y., announces the appointment of **Davis-K Products,** New York City, as a distributor in this area. Distributor for the West Coast is the

Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Subscriptions: Domestic and Canada, $4.00 for 1 year, $7.00 for 2 years 50c per copy; Foreign $8.00 per year. $1.00 per copy.

KAYNIDE-- Bright Copper the *easy* way-- *and you can get it* NOW!

STOP WORRYING ABOUT COPPER CHEMICAL SHORTAGES. It's easy to get started *at once* with an efficient Bright Copper Bath—with no complicated installations . . . and to be sure that your operation will be uninterrupted by shortages of copper cyanide and other materials.

KRAFT—a major supplier of raw materials to industry—maintains ample supplies of the copper chemicals and brightening agents which you will need for day-in-day-out production . . . and Kraft's KAYTROL Continuous Check control system protects your quality on every run.

There is a Kraft KAYNIDE solution or brightener to fit your requirements for *any* alkaline copper bath:

KAYNIDE CU1000—a *complete* concentration for a bright copper bath, requiring only the addition of water . . . for universal use with *any* alkaline sodium copper bath.

KAYNIDE CU1125—a similar concentration, modified for makeup use.

KAYNIDE CUK1000—similar to CU1000, except compounded with potassium only and without sodium . . . and tested for periodic reverse processes.

KAYBRITE CUB1—a carefully prepared concentrated additive for giving high brightness and refined grain in KAYNIDE baths.

KAYBRITE CUB2—for heightening brightness and broadening operating ranges of CUB1.

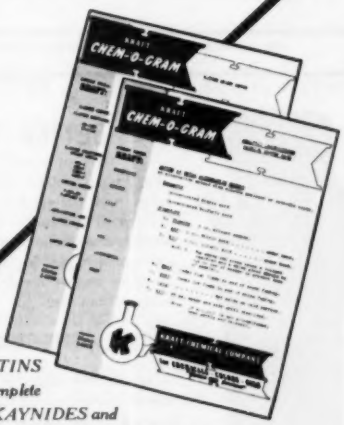
KAYBRITE FASPLATE—a specially prepared chemical additive to provide very fast plating—with *dense*, ductile copper—at very high current densities . . . ideal for heat treat stop-off.

KAYNIDE ZN1000—a complete concentration, requiring only the addition of water, for a bright *zinc* bath.

Here are a few of the advantages of adopting the KRAFT KAYNIDE Bright Copper Bath:

1) *You need no longer scramble for hard-to-get copper and other chemicals.*
2) *The KAYNIDE bath operates at low temperatures . . . for higher solution stability, with practically no break-up of cyanide.*
3) *The KAYNIDE bath operates at normal current densities.*
4) *The KAYNIDE bath is versatile . . . you can plate articles of widely varying shapes.*
5) *The KAYNIDE bath maintains brightness over a wide range of operating conditions.*
6) *The KAYNIDE bath will save on buffing costs.*

ACT TODAY TO GET THE FACTS!



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KRAFT CHEMICAL COMPANY
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"Your one Source"

GENTLEMEN: Please send us bulletins on installation, use, servicing and costs of KAYNIDE and KAYBRITE complete self-contained high-brightness Copper Plating Baths and Additives.

We are now using.....
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You'll be SAFE

WITH STORTSWELDED TANKS

You'll score on utility and long-lasting value. When Storts quotes on your inquiries for tanks, or other welded fabrications, you get a complete description of just how your work will be done. You know in advance what kind of welding and how much welding will be used to make you safe from wear-outs and pay-outs for repair or replacement. The wide margin of safety in Stortswelded construction is a paying investment.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

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The True Insulator will give you more safety than before with the same standard of insulation as always. Wire braid hose on the ¾" and 1" sizes insures absolute freedom from failure. The ½" size has been completely redesigned to give higher quality with longer life. With all these improvements the True Insulator is a better bargain than ever.

THE TRUE INSULATOR

is specifically manufactured to insulate your plating operations from grounds and short circuits through the heating coils, cooling coils, air agitation systems or other pipe connections. The True Insulator provides more positive insulation than any other type known.

Available in following sizes

½ inch.....$7.00 per pair
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1 inch.....$8.50 per pair

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Industry News

L. H. Butcher Company, of Los Angeles, Calif.; San Francisco, Calif.; Seattle, Wash.; Salt Lake City, Utah, and Portland, Ore.

Acme Manufacturing in New Plant. After nearly half a century in its old location at 1645 Howard St., Detroit, Acme Manufacturing Company, manufacturers of automatic polishing and buffing machines, has moved to a recently completed plant at 1400 E. 9 Mile Rd., Ferndale, Mich., easily accessible from downtown Detroit. It is thoroughly modern, with

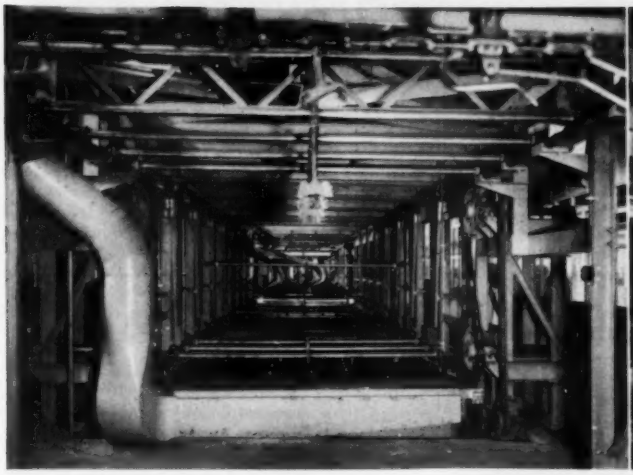
every facility for efficient manufacturing, and allows ample room for present operations and future expansion. Added equipment and facilities for engineering and experimental work have been provided. The new facilities will permit machine displays under power, enabling customers to see polishing, buffing, deburring and microfinishing of actual parts.

Established in 1910 by G. C. Carlson, Acme Manufacturing pioneered the design, development and manufacture of automatic and semiautomatic polishing and buffing machines, introducing these units to the young automotive industry. Other industries soon installed Acme machines. The company engineered and developed rotary, straightline, semiautomatic and special machines which are now in wide use in a great many industries here and abroad for low-cost production finishing. During World War II, Acme produced a variety of automatic machines for finishing of shells, aircraft and other parts, and engineered special fixtures to handle such jobs at high-production levels.

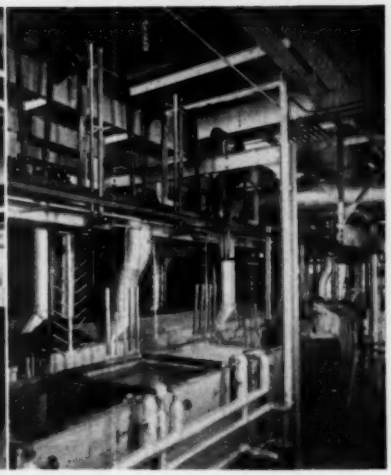
Electroplating Scholarship Winners. The Joseph B. Kushner Electroplating School, Stroudsburg, 1C, Pa., announces that two scholarships in "Electroplating Know How", the corre-

Manns Chisholm

in your plating How to Get Greater Production Improved Quality Better Working Conditions

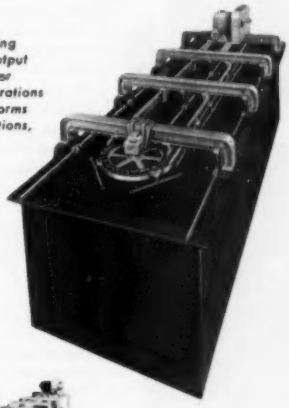


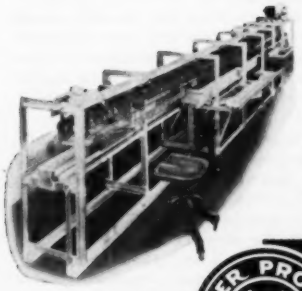
Typical Meaker Straight-A-Way Automatic Plating Machine. This type unit is designed to handle 125 racks or more per hour.



Meaker Return-Type Automatic Plating Machine for chromium-plating the large variety of parts in a high-quality line of plumbing hardware. Machine may be designed to copper plate, nickel plate and chromium plate in one continuous line.

A Meaker Semi-Automatic Plating Machine for use in medium-output plating departments and also for supplementing the plating operations in a Full Automatic which performs the cleaning, preplating operations, final rinsing and drying.





A special machine designed by Meaker for cleaning and silver plating small, brass contact clips.

You Get All Three with Meaker

Here's how! A Meaker plating machine makes every operation in the plating sequence automatic, or as mechanized as possible. This cuts to a minimum the manual handling of the parts in process—increasing production. The control of the quality of the plating is set and practically independent of the varying human element. A Meaker plating machine does clean up the plating room making for safer and more agreeable working conditions. And a bonus—in many cases the savings in the over-all plating costs have paid for the equipment in a short time.

Look to the handling methods in your plating department. You might be surprised what modern methods will accomplish. Whatever your requirements—full automatic, semi-automatic, or a special machine—Meaker has the answer.

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Serving the Plating Industry for Over 50 Years

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spondence training course in modern electroplating technique, sponsored by the Fulton Asphalt Company, builders of plating-room floors, have been won by Thomas J. Manns, plating chemist and engineer in charge of the Philco Corporation's plating plant at Lansdale, Pa., and John F. Chisholm, dipper and plater's helper at the Watertown Arsenal, Watertown, Mass. Their courses will begin at once.

Ezra Blount, Editor of Products Finishing; George B. Hogaboom, Sr.; Walter Raymond, Editor of Metal Finishing, and Gustaf Soderberg, Editor of PLATING, acted as judges of the competition.

The scholarship contest, which called for a fifty-word statement beginning with the words "Electroplaters should be able o *think* plating as well as do plating because", resulted in a large volume of entries from all over the world by executives, engineers and chemists, plating foremen, platers, and helpers. The judges were hard put to make the final choices because of the overall excellence of the many entries. Free copies of the prize-winning statements may be had from the School.

The Diversey Corporation, cleaners manufacturer, gathered the district managers of its field-service organization in the Edgewater Beach Hotel, Chicago, June 8 and 9 for a clinic on sales management. W. E. Noyes, Diversey's vice-president in charge of sales (seated extreme right in photo) presided at all sessions.

over
one million amps
of Sel-Rex
PLATING POWER
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WE are proud of the success record Sel-Rex Selenium Rectifiers enjoy in the world's largest plating plants . . . (one company alone has over 56,000 amps of Sel-Rex Plating Power).
The largest single unit rectifier built to date is a Sel-Rex development. No matter how small or large your power requirements may be, Sel-Rex Rectifiers can be designed and built to suit your special needs.
Specialists in Plating Power to the Electroplating Industry
Automatically controlled by this operating panel
NEMA
SELENIUM Sel-Rex RECTIFIERS
BART-MESSING CORPORATION
229 Main Street • Belleville 9, N. J.
Manufacturers and distributors of Plating and Polishing Equipment and Supplies.

Industrial Finishing Exposition. The American Electroplaters' Society has appointed Glassner & Associates, Public Relations, Chicago, to manage and promote the Society-sponsored Industrial Finishing Exposition scheduled for June 16–20, 1952 at the International Amphitheatre, Chicago. The exposition is being held in conjunction with the Society's 39th Annual Convention at the Stevens Hotel. Previous Expositions have been sponsored by the Society in Detroit and Atlantic City. Along with manufacturers of plating equipment and supplies, plating instruments, and paint and allied equipment, companies in related and service fields such as abrasives, masking tapes, chemicals, polishing and buffing, safety devices, materials-handling apparatus, etc., are invited to exhibit. Inquiries should be addressed to the Industrial Finishing Exposition, Suite 1268–78, 35 E. Wacker Drive, Chicago 1, Ill.

Bacon Felt Company now carries on all its activities—sales, engineering, and production—in its new Taunton, Mass., factory, to which it recently moved from Winchester. With new, specially designed felting equipment and larger production facilities, the company will be in a stronger position to serve industry in its requirements of felt wheels, bobs, and sheets.

Graham, Crowley & Associates, Inc., have moved their Chicago research division to greatly enlarged quarters, located at 341 E. Ohio St., Chicago 11, Ill. The company has long been identified with the electrochemical industry, specializing in the field of primary batteries, secondary batteries, electrodeposition, and electro-organic research.

Electroplating Course in Brooklyn. A course in Electroplating is to be given at the Brooklyn Evening Technical High School, 29 Fort Greene Place, Brooklyn

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and superior by every standard of comparison . . . and costs less!

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HEAT-CURED RACK COATING

● Now, the Michigan Chrome and Chemical Company laboratories have improved their single-dip heat-cured rack coating which offers, in addition to positive insulation and protection: (1) amazing tensile strength and scuff resistance; (2) permanent flexibility; (3) positive and continuous adhesion; (4) simplicity of application; (5) savings in time, labor, and material . . . a major objective of chemical engineers for years.

● Exhaustive tests reveal the marked superiority of Improved MICCROSOL E-1003 in every important manner of comparison. In addition to the outstanding characteristics listed above, tests for abrasion and resistance to all commonly used plating solutions, acids, and caustics show superior performance in comparison to similar products.

● Improved MICCROSOL E-1003 is a 100% solids non-evaporating material that produces a smooth, tough, leather-like coating with a single application which will often outlast the life of the rack. Racks are completely processed and ready for use in approximately 2 to 4 hours.

● Has exceptionally high gloss, allowing free drainage and no solution carry-over.

● If you are not prepared to coat your racks, write us and we will be glad to furnish the name of the applicator nearest you who is equipped to apply Improved MICCROSOL E-1003 Heat-Cured Rack Coating.

It's Improved in Every Respect!

Write for detailed bulletin.

MICHIGAN CHROME
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MURRAY-WAY is THE BETTER-WAY of automatic buffing, polishing and grinding

Murray-Way's complete standard line of "production tested" automatic polishing, buffing and grinding equipment has been developed through years of experience and actual application in plants throughout the country.

The combination of these versatile production-tested units and smart Murray-Way engineering will give you right-the-first-time installations without delay or trouble.

If you have a metal surfacing problem that calls for special-built equipment, Murray-Way is your answer. During the last war, our engineering staff speeded the conversion of many manufacturers with automatic metal surfacing equipment specially designed to accomplish jobs never before attempted. This valuable experience is yours for the asking.

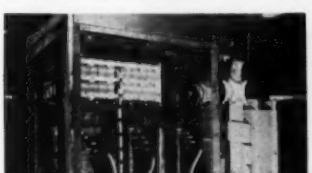
THE MURRAY-WAY CORPORATION
POST OFFICE BOX 180—BIRMINGHAM, MICHIGAN

Our new, large plant facilities are shown below.

I, N. Y. This course is free and is open to men in the plating industry. The new term will commence on September 12, with registration from 7:00 to 8:30 P. M. on September 10 and 11. Classes are held from 6:30 to 8:20 P. M. Inquiries should be made to the general-office room 1W2 or BW 17.

The course includes a review of elementary chemistry; units of weights and measures used in preparing bath formulas, including methods of determining density; complete analysis of copper, nickel, chromium and cyanide baths; the use of *p*H meters; thickness measurements of electrodeposits by microscopic and chemical methods; hardness tests. Classwork is supplemented by laboratory work. Further study will include the preparation and operation of common electroplating baths.

World's Largest Selenium Rectifier. Engineers of the Bart-Messing Corporation, Belleville, N. J., recently developed what is said to be the largest single-unit selenium rectifier ever built. With a ca-



pacity of 13,000 amperes at 14 volts, it has almost double the capacity of any previously built unit. It is installed in the plating plant of one of the country's leading automobile manufacturers. Hermetically sealed against corrosion, the rectifier is automatically controlled by means of saturable reactors and electronic circuits to maintain constant voltage.

A. S. T. M. Emergency Specifications and Alternate Provisions. In the interest of expediting procurement or conservation of materials during the National Emergency and at the urgent request of several technical committees in such fields as rubber products, steel, and corrosion-resistant alloys, the Board of Directors of the American Society for Testing Materials, at its meeting on May 8, approved a procedure for the issuance of Emergency Specifications and Emergency Alternate Provisions. In most details the mechanics to be followed and the method of issuing will parallel similar procedures used during World War II. The Emergency Provisions will be on a voluntary basis.

a radically new type of
chromate finish for zinc and cadmium

IRIDITE #8P

NEW LOW MATERIAL COSTS!

Each gallon of working solution you mix costs from as little as 35¢ down to only 8¼¢, depending upon solution concentration and appearance desired. In addition, you get an extra 10% discount on material orders for 2000 pounds or more!

NEW LOW SHIPPING COSTS!

Iridite #8P is shipped to you as a *dry powder* in disposable steel pails. No liquids! No carboys! Saves up to 75% in freight; travels via low Third Class Rates. Pails take less storage space, reduce handling time and costs.

NEW BRIGHT OR GOLDEN FINISH!

A sparkling blue-bright finish results when you use Iridite #8P followed by a simple caustic soda bleach. Or, the coating can be produced as a golden-yellow iridescent film from a single dip by simply decreasing the concentration.

NEW ALL-PURPOSE USE!

New Iridite #8P can be applied by a simple chemical dip to any zinc or cadmium surface . . . plated, diecast, galvanized or sheet. Mixing is easy since the powder dissolves readily into solution. No special equipment or specially trained personnel is needed. Corrosion resistance is determined by the appearance desired; the choice is up to you. But for any appearance you are assured of maximum Iridite quality in corrosion resistant and paint base characteristics.

WRITE FOR FREE TEST SAMPLE or send samples of your product for finishing with new Iridite #8P. See for yourself how this amazing new Iridite treatment can cut your finishing costs.

Iridite is approved under government specifications.

ALLIED RESEARCH PRODUCTS
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Available for Immediate Shipment, Attractive Values

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

1—7500/3750 AMPERE, 6/12 VOLT, **A. P. MUNNING** "OPTIMUS." Separately Excited.

1—6000 AMPERE, 2-6 VOLT, **JANTZ & LEIST.** Separately Excited.

1—6000/3000 AMP, 6/12 VOLT, **BOGUE.** Synchronous Motor. Separately Excited.

1—5000/2500 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Synchronous Motor. Separately Excited.

1—5000/2500 AMPERE, 6/12 VOLT, **EAGER ELECTRIC CO.** Separately Excited.

1—3000/1500 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Synchronous Motor. Exciter-in-Head.

1—2000/1000 AMPERE, 6/12 VOLT, **A. P. MUNNING** "OPTIMUS."

1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING CO.**

1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS CO.** Separately Excited.

1—2000 AMPERE, 50 VOLT, **CHANDEYSSON ELECTRIC CO.** ANODIZER. Synchronous Motor. Exciter-in-Head.

2—1000 AMPERE, 30 VOLT, **IDEAL** ANODIZERS. Exciter-in-Head.

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2—500 AMPERE, 40 VOLT, **"M. G. C."** ANODIZERS. Separately Excited.

1—400 AMPERE, 40 VOLT, **"M.G.C."** ANODIZER. Separately Excited.

5—**GREEN SELECTROPLATERS,** 1800 AMPERES, 12 VOLTS, for 220/3/60 A.C.

1—**GENERAL ELECTRIC CO.** COPPER OXIDE RECTIFIER, 2000 AMPERES, 6 VOLTS, for 220/3/60 A.C.

2—**UDYLITE-MALLORY** RECTIFIERS, 1440/720 AMPERES, 6/12 VOLTS, for 220/440/3/60 A.C.

4—**GENERAL ELECTRIC** COPPER OXIDE RECTIFIERS, 500 AMPERES, 6 VOLTS, for 220/3/60 A.C.

1—USED **UDYLITE** SEMI-AUTOMATIC KOROSEAL-LINED PLATING MACHINE. 19' x 61" x 54".

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Personals

Clarke W. Clemmer, Jr., is now Eastern Division Equipment Engineer of the Cro-Plate Company, Inc., of Hartford, Conn. He will be concerned with engineering and sales of the Company's wet-blasting and chromium-plating units in

Clemmer

the Connecticut and Massachusetts area.

A graduate of Yale, Mr. Clemmer was formerly engaged in refrigeration research for Westinghouse as an engineering laboratory technician.

Dr. Ivor E. Campbell, known in the metallurgical field for his research on the preparation of metals by vapor-phase deposition, has been appointed Supervisor of Research on chemical problems in nonferrous metallurgy at Battelle Institute, Columbus, Ohio. His responsibilities include direction of Battelle's studies in the preparation and production of nonferrous metals.

N. G. Denbroeder has joined the Arthur B. Sonneborn Company in its Toledo Ohio office, where he will be associated with Shep Kinsman. As Application Engineer, he will handle the sale and application of the line of motor-generators and large motors and generators manufactured by The Electric Products Company. Since his graduation from Detroit Institute of Technology as an Electrical Engineer, Mr. Denbroeder has spent several years in industrial sales and engineering.

Charles McNally of Byfield, Mass., is now Sales Engineer in charge of eastern New England for Industrial Supplies & Equipment Company, Greenwich, Conn.

A graduate of the University of New Hampshire, Mr. McNally is both a Chemical Engineer and a Mechanical Engineer. He secured his early metal-working experience with Scott and Williams in Laconia, N. H. Joining the River Works General Electric Company, Lynn, Mass., as a tool and die maker, he was soon transferred to Methods and Planning and then assigned to the Metal Finishing Department, of which he became Supervisor. For many years, he has been a member of the Boston Branch of the American Electroplaters' Society. Mr. McNally's territory includes the eastern half of Massachusetts, Rhode Island, New Hampshire, and Maine

Thomas R. Williams is now Sales Engineer in the Plating and Polishing Department of Frederic B. Stevens, Inc., Detroit, and will represent the Stevens line in Eastern Ohio, with headquarters at Elyria, Ohio.

Williams

He was formerly a laboratory technician with the Brown-Lipe-Chapin Division of General Motors Corporation in Elyria and has considerable experience in plating solution maintenance, quality control and trouble shooting. He has a B.S. degree in Chemistry from Alma College, Alma, Mich., and has done graduate work at Wayne University, Detroit.

Williams is a member of the Detroit Branch of the American Electroplaters' Society.

Robert H. Campbell has been appointed Cowles Technical Man for the Metal Cleaner Department in Cowles Chemical Company's new sales territory comprising southern Illinois and St. Louis, Mo.

Campbell

Mr. Campbell attended the University of Illinois and Rockford College, specializing in chemistry, then worked for a number of years for National Lock Company, first in the plating laboratory and then as assistant foreman of the plating line.

Frederick S. Foster has been promoted to Assistant to the Vice-President of Apothecaries Hall Company.

A graduate of DePauw University, Greencastle, Ind., in 1932, where he majored in chemistry, he was elected to Phi Beta Kappa. He took one year postgraduate work at Colgate University.

Mr. Foster has been associated with Apothecaries Hall Company since 1934.

2 Types to choose from

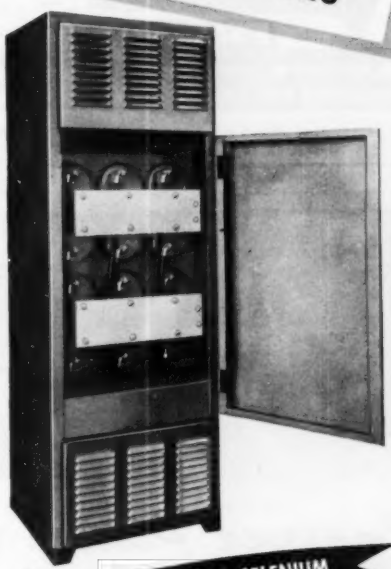
PLATING RECTIFIERS

AIR-COOLED COPPER OXIDE

Greater efficiency at plating currents and less change in characteristics with aging has made copper-oxide one of the most popular of all plating rectifiers. These two features—which mean lower power costs over more years of service—continue to make copper-oxide the top choice for heavy-duty operations, particularly in automatic plating installations.

G-E copper-oxide rectifiers are available with either automatic or manual control. For the ultimate in uniform plating, predictable plating costs and minimum labor, G.E.'s automatic system is your choice. For dependable plating current—with simple, convenient, "at-the-load" current control which is moderate in initial cost—use G-E manually controlled copper-oxide rectifiers.

For complete details, write for Bulletin GEA-5247.



OIL-IMMERSED SELENIUM

General Electric's new oil-immersed selenium rectifiers have been especially designed to operate in corrosive or dusty, linty atmospheres. Rectifier stacks are hermetically sealed in welded, oil-filled cans—can be installed right next to your tank and still give long dependable service. This new selenium rectifier is ideal for barrel plating, too. The high thermal capacity of its oil, plus improved ventilation, enable this rectifier to withstand brief current fluctuations with safety.

Lower initial cost is the third important feature of oil-immersed selenium—and will often outweigh the somewhat higher efficiency of copper-oxide when power costs are not a controlling factor.

For complete details, write for Bulletin GEA-5519.

For application information, call your General Electric Apparatus Department Sales Representative or authorized G-E Agent. *Apparatus Department, General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

464-5

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Attach this Ad to your Letterhead and Receive Free Our New 1951 Buffing Compound and Platers Supplies Catalog

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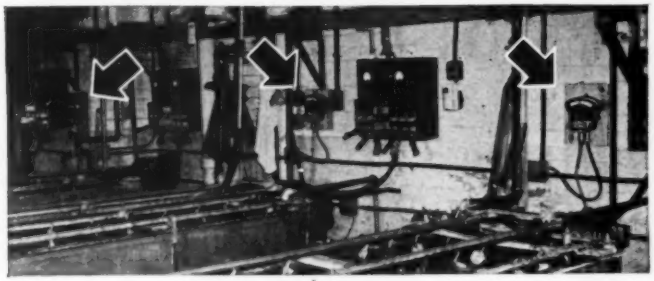

Improved Plating WITH SARCO

Controlled temperatures mean uniform, high quality plating, day in and out. You can control wash tank temperatures with the Sarco Thermoton at a cost of a few dollars. Most plating tanks can be controlled with the Sarco "LSI" electric control which costs much less than most methods. For special and highly accurate controls for vapor-line and heating and cooling there are a dozen different Sarco combinations. Four types of Sarco Steam Traps help reduce fuel costs.

SARCO CATALOGS

No. 1025
LSI ELECTRIC CONTROL

No. 700
TR-40 COOLING CONTROL

No. 650
VAPOR-LINE CONTROL

No. 600
TANK TEMPERATURE CONTROLS

No. 550
THERMOTONS

Nos. 250, 350 & 450
THERMOSTATIC, BUCKET AND FLOAT-THERMOSTATIC STEAM TRAPS

No. 1200
PIPE LINE STRAINERS

219-A

SARCO SAVES STEAM
IMPROVES PRODUCT QUALITY AND OUTPUT

SARCO COMPANY, INC.
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Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

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Personals

He worked in the company's analytical and research laboratory for seven years, and was then in charge of allocations and priorities for three years. For seven years Mr. Foster has been in the sales department, and since 1948 has served in the capacity of sales engineer. In his new position Mr. Foster will be in charge of purchasing and sales promotion of the company's heavy-chemical and plating-supply departments. He will also have certain general administrative responsibilities.

Herbert B. Link, Executive Vice-President since 1939 of The Bellows Company, Akron, Ohio, manufacturer of pneumatic equipment, has been named President of the company. He succeeds L. F. R. Bellows, who died on May 28. **L. F. R. Bellows, Jr.,** Detroit, Mich., has been made Vice-President, and **Byron D. Kuth,** of Cleveland, Ohio, Secretary-Treasurer.

Link

Bellows

The Bellows Company was organized in 1939 by Mr. Bellows and Mr. Link to manufacture pneumatic accessories. The company has since grown to have plants in Cuyahoga Falls, Ohio; Warsaw, Ind.; Detroit, Mich.; and Los Angeles.

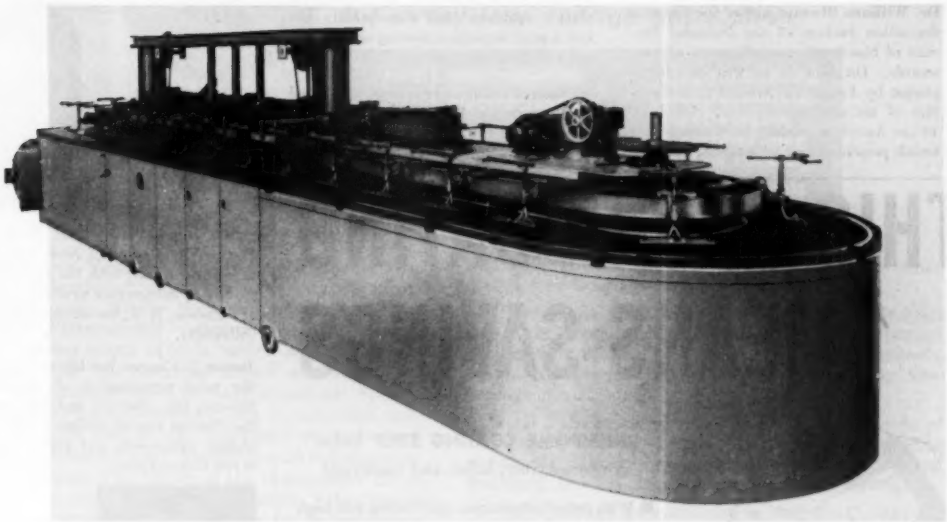
Truman S. Fuller, Engineer in Charge of Works Laboratory, General Electric Company, Schenectady 5, N. Y., was elected President of the American Society for Testing Materials, it was announced at the Society's 54th Annual Meeting in Atlantic City, N. J., week of June 18.

Born in Saratoga Springs, N. Y., Mr. Fuller graduated from Syracuse University in 1911 with a degree of B.S. in Chemistry. He entered the employ of the General Electric Company as Chemist at the Edison Lamp Works, Harrison, N. J., in 1911. Three months later he was transferred to the Research Laboratory at Schenectady as Metallurgist. In 1938 he became Engineer of Materials, Works Laboratory; in 1943 Assistant Engineer of that division; and on July 1, 1945 was appointed Engineer in Charge of the Works Laboratory.

Participating in A. S. T. M. work for many years, he is a former member of the Board of Directors, having served in

CROWN TYPE "C" AUTOMATIC

for plating and cleaning . . .



STREAMLINE your plating operations — get a better quality of work at lower cost by installing Crown automatic equipment. You'll benefit immediately by a better control of production schedules — uniformity of plating — elimination of human variables and a reduction in plating costs.

Investigate the possibilities of Crown automatic equipment for your plating operation — give us details of your requirements for additional information.

TYPE "C" MACHINE — (up to 50 ft. lengths) can be shipped in operating order as per following specifications:

1. Two Units on standard transport trucks.
2. Maximum shipping dimensions per unit 26′ long x 6½′ wide x 7½′ high. (Above units will go through most plant doors and aisleways.)
3. Tanks 42″ deep.
4. Maximum effective area of racks 28″ long x 18″ wide.
5. Maximum treatment for given floor space.
6. High speed vertical agitation (up to 18 ft. per minute can be built into machine.)

CROWN RHEOSTAT AND SUPPLY COMPANY

3465 N. KIMBALL AVENUE • CHICAGO 18, ILLINOIS

Personals

1939–1941 and again in 1947–1950. He was elected Vice-President last year. He has been an active member of a large number of A. S. T. M. technical committees in many materials fields. A long-time member of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, he served as Chairman of this important committee from 1926 to 1940, when the committee inaugurated many extensive corrosion tests.

Dr. William Blum, Chief of the Electrodeposition Section of the National Bureau of Standards, recently received two awards. On June 18 he was awarded a plaque by Frankford Arsenal in recognition of his advisory services. On June 19 the American Society for Testing Materials presented him with the A. S. T. M. Award of Merit. The citation accompanying the latter award read as follows: "To William Blum, Chief of the Electrodeposition Section and Assistant Chief of the Chemistry Division, National Bureau of Standards, Washington, D. C., in recognition of pioneering research leading to development of a widely used group of specifications for electrodeposited coatings which in large measure have been responsible for improved quality of plated materials. His early work, which was continued in Committee B-8 on Electrodeposited Metallic Coatings, resulted in a much better knowledge of plating and plating solutions, and consequently has had a most important bearing on this segment of American industry."

William F. Lucas has been appointed Assistant to the Western Region Manager of Detrex Corporation, Detroit, Mich. He will make his headquarters in the Chicago office, 600 S. Michigan Ave., and will supervise the technical applications and the field servicing of Perm-Cote phosphate-type rust-proofing compounds and Detrex alkaline and emulsion cleaners in Wisconsin and northern Illinois.

Richard J. Dunne has been appointed Eastern Division Sales Engineer for the Cro-Plate Company, Inc., of Hartford, Conn. In his new position, he will serve the hard-chromium plating needs of metal working plants and printing houses in the New York and New Jersey area.

Dunne

Mr. Dunne comes from the Cylinder Plating Corporation of New York, where he was concerned with the sale of copper plating to rotogravure printers. A native of Paterson, N. J., he attended New York University.

James J. Cooper has been appointed to the sales organization of Frederic B. Stevens, Inc., Detroit, and will represent the Stevens line of buffing compositions, plating equipment, and plater's supplies in the Chicago area.

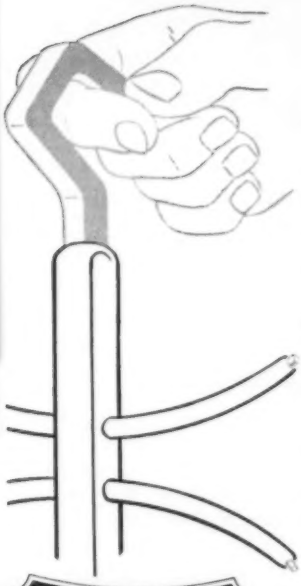
Cooper

For the past five years he has been a sales representative for a distributor of chemicals and minerals for the metal-finishing industry. His prior experience was obtained in the metal working and chemical-processing trade.

R. L. McCann at a recent meeting of the Board of Directors of the New Jersey Zinc Company, was elected President of the Company. He succeeds **Henry Hardenbergh,** who was elected Chairman of the Board. Mr. McCann was formerly General Manager of Mines of the Company.

A. J. Steffens, Jr., has been appointed Sales Engineer for the Osborn Manufacturing Company, Cleveland, Ohio. Mr. Steffens will handle the company's line of industrial wire brushes in North and South Carolina, Eastern Georgia and Florida. He will live in Westover Hills, Charlotte, N.C.

THIS RACK COATING MEANS SAVINGS



UNICHROME COATING 218X *helps conserve time, labor and materials*

■ With today's shortages, restrictions and high operating costs, it pays more than ever to give your racks the protection of Unichrome Coating 218X. You'll be able to work racks longer, harder in all plating cycles—and cut costs and waste besides. Here's why:

This green baked-on plastisol coating has *flexibility, body, chemical inertness* and remarkable *toughness.* With only a *single* time-saving application of Unichrome Primer 219PX, you assure outstanding adhesion of the chip- and scuff-resistant Coating 218X in strongest plating baths and cleaners—vapor degreasing cycles included. Its proved ability to maintain a smooth, free-rinsing surface, free from damage and blisters, not only means less maintenance, but also less contamination of vital plating solutions by drag-in and less waste by drag-out.

To cut expenses, use Unichrome Coating 218X on all your racks. You can easily apply it yourself, or can have a nearby qualified applicator do it for you. We'll send you names. Write us.

UNICHROME Trade Mark **COATINGS for METALS**

Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Products of UNITED CHROMIUM, INCORPORATED

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Los Angeles 13, Calif. • In Canada: United Chromium Limited, Toronto, Ont.

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PLATEMANSHIP

H-VW-M's unique combination of:

. . . the most modern and complete laboratory for testing and development

. . . ability to provide complete equipment and materials for every plating and polishing need

. . . the complete background of knowledge and experience in every aspect of plating and polishing.

H-VW-M and PLATEMANSHIP *provide direct current motor generator sets for every low voltage application*

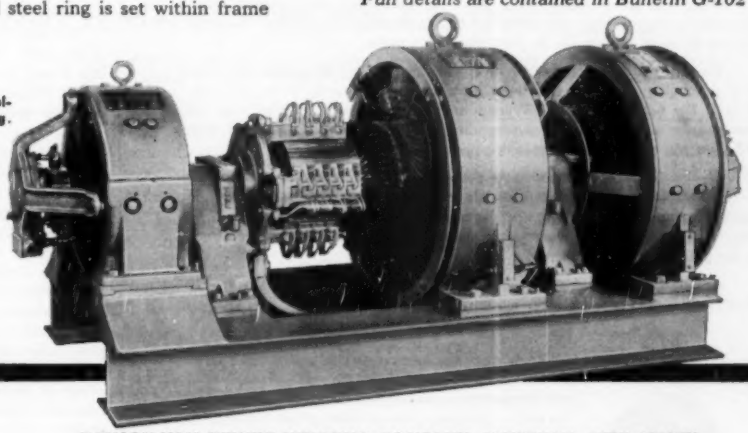
. . . a	electroplating	electropolishing
complete	electrocleaning	electrocoloring
	anodizing	electrotyping
line	manodizing	electroforming
for	electrolytic production of chemicals	metals refining

H-VW-M Low Voltage Motor Generators have been constantly developed and improved since their introduction in 1876. Today they embody such typical H-VW-M *Platemanship* refinements as one piece bronze casting brush holders, which are completely insulated from the electrical circuit and supported from the bearing pedestal for easy inspection. Special copper graphite brushes insure long life and high conductivity, while moulded-in "Equaload" shunts reduce resistance, eliminate selective action and equalize current distribution. Fan action of the commutator risers ventilates commutator and field coils. Vibration is reduced because rolled steel ring is set within frame and long-term trouble-free life is assured by oversize sleeve-type bearings.

H-VW-M Low Voltage Generators are available from 200 to 25,000 amperes and in standard voltage ratings from 6 through 60. To handle special requirements, H-VW-M designs and builds sets to meet any low-voltage condition.

In Low Voltage Generators—as in all other needs of the industry—H-VW-M and *Platemanship* are able to supply the right equipment for every phase of pickling, polishing, buffing, cleaning, anodizing and plating.

Full details are contained in Bulletin G-102



25-volt generator for sulfuric acid anodizing. H-VW-M is also a leading manufacturer of 40-volt motor generator sets with exclusive automatic control for chromic acid anodizing.

HANSON-VAN WINKLE-MUNNING COMPANY, MATAWAN, NEW JERSEY

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INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

THIS MAN FITS INTO YOUR

DEFENSE PRODUCTION PLANS

When you get an order that calls for metal cleaning, be sure to call your Wyandotte Representative. He can put Wyandotte's vast technical knowledge at your disposal to help you in your conversion plans.

During, and since, World War II, a large part of Wyandotte research and production facilities has been devoted exclusively to metal cleaning. This is the background your Wyandotte Representative can offer you. Let him go over your contract, recommending the procedures and products* that will give you the best metal-cleaning operation.

Wyandotte is your dependable source of cleaning supplies. Production is dependable because raw materials come from Wyandotte owned and operated sources. Deliveries are dependable because supplies come from Wyandotte's nationwide warehouses, ready to meet your normal or emergency production requirements.

So whatever your cleaning needs may be, call or write your Wyandotte Representative. You'll find that he knows his business.

*Wyandotte offers products which meet the process requirements of JAN-C-490 Grade II, Type 2 and 6.

THE WYANDOTTE LINE—products for burnishing and burring, vat, electro, steam gun, washing machine and emulsion cleaning, paint stripping, acid pickling, related surface treatments and spray booth compounds. An all-purpose floor absorbent: Zorball. In fact, specialized products for every cleaning need.

WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN
Service Representatives in 88 Cities

Wyandotte
REG. U. S. PAT. OFF.

Trade Literature

L—647. Flexible Burring. The outstanding characteristic of the Lea Method of Burring, its flexibility, is described in a booklet on Lea Burring Method, issued by The Lea Manufacturing Company, 16 Cherry Ave., Waterbury 20, Conn., and The Lea Manufacturing Company of Canada, Ltd., 370 Victoria St., Toronto 2, Ontario. It gives standard practices for both ferrous and nonferrous metals and full instructions as to which wheel and compound to use.

Operations are carried on by the use of suitable cloth or felt wheels or bobs, coated with a suitable grade of Lea Compound. By use of these wheels and bobs, the operator is said to have much better control over the removal of sharp edges, jagged surfaces, fins, slight surface imperfections, etc., than when hard burring tools or hand-applied emery cloth are used, and is better able to stay within close tolerances. For your copy, use Reader Service Card.

L—648. Paint Adhesion to Zinc and Cadmium—American Chemical Paint Company, Ambler, Pa., has issued a 4-page bulletin, "Lithoform", which describes the zinc phosphate coating process, gives details of how it functions, and shows its application by power spraying and dipping. For your copy, use Reader Service Card.

L—649. Black Oxide Coating Process—The Mitchell-Bradford Chemical Company, 2446 Main St., Stratford, Conn., has issued several bulletins describing the Black Magic, Type A process for iron and steel, a decided improvement over the regular Black Magic process. Operating instructions are also furnished. For your copies, use Reader Service Card.

L—650. Demineralizer—The Industrial Filter & Pump Manufacturing Company, 5900 Ogden Ave., Chicago 50, Ill., has issued a 4-page catalog giving detailed information, with principal specifications and performance data, on its standard demineralizer units for low-cost chemically pure water. Besides a general description of the construction, installation, and operation of Industrial demineralizers, this catalog explains the principle of demineralizers, gives suggestions for their use and application for various manufacturing and chemical processes. For your copy, use Reader Service Card.

L—651. Carbon Brushes—A 2-color, 28-page booklet, "Carbon Brushes for Electric Equipment", is available from the General Electric Company, Schenectady 5, N. Y.

FULL LENGTH "CONDUCTA-CORE" INCREASES CONDUCTIVITY, RIGIDITY

Federated Conducta-Core Lead Anodes have a highly conductive and non-contaminating ⅜" diameter aluminum rod running from top to bottom. This, together with the unique design of the anode, assures complete rigidity . . . there is no curling, buckling or peeling to interfere with automatic plating operations.

The Conducta-Core makes every inch of the anode highly and uniformly conductive . . . more current can be carried than by ordinary anodes. Another advantage of the Conducta-Core Anode is the great number of high projections that give it greater-than-average throwing power.

No need to worry about anodes dropping into the tank because of corroded hooks . . . an improved lead coating 3/16" thick at the base of the copper hook is your guarantee of permanently attached anodes.

Federated Conducta-Core Anodes are available in all standard lengths up to 52 inches, and with a variety of hooks. Special sizes made to order. Flat Rolled and 3-Rib Lead Anodes can also be supplied.

Federated Metals Division

federated first in the non-ferrous field. FMD

AMERICAN SMELTING AND REFINING COMPANY • 120 BROADWAY, NEW YORK 5, N. Y.

Trade Literature

Designated as publication GEA-5597, it describes and illustrates the fundamental considerations given to the design, application, and manufacture of carbon brushes, and includes a section on brush terminology. Produced to familiarize users with the physical characteristics that must be known before proper recommendation can be made for a brush application, the booklet also tells of the engineering services offered by G. E. to help solve specific brush problems.

Included are sections on types of brushes, characteristics of brush grades, brush grade recommendations, mechanical design of brushes, and tips on brush replacement. For your copy, write to the company and mention PLATING.

L—652. Barrel Finishing—Faster production and better finishes by barrel finishing of metal parts is described in a booklet available from Minnesota Mining and Manufacturing Company, 900 Fauquier St., St. Paul, Minn. The illustrated 12-page, two-color booklet, "3M Barrel Finishing", tells what barrel finishing is, who can use it, and what specific advantages it offers. It gives new applications for "Honite" and "Super Honite" abrasive chips, "Honite" compounds, and new 3M barrel finishing equipment. Illustrated are deburring, surface-finishing and precision-finishing of a wide variety of machined parts, metal stampings, simple forgings, castings, and many other metal parts. For your copy, use Reader Service Card.

L—653. Brighteners, Finishes for Non-Ferrous Metals—Allied Research Products, Inc., 4004 E. Monument St., Baltimore 5, Md., has issued a 4-page, 2-color bulletin describing in detail the entire line of Iridite finishes for non-ferrous metals. A section of the bulletin also covers the ARP process chemicals, which include brighteners for zinc and cadmium plating and other specialties.

The technical data is presented in chart form and describes the four major functions of Iridite: corrosion resistance, paint adhesion, eye appeal, and technical advantages, in terms of their relation to three categories of metallic surfaces: zinc and cadmium, aluminum, and cuprous alloys. For your copy, use Reader Service Card.

L—654. Corrosion-Resistant Cement—The Atlas Mineral Products Company, Mertztown, Pa., announces Vitroplast, a newly developed light-colored synthetic-resin cement, which is resistant to many acids, solvents, greases and oxidizing agents. Vitroplast sets hard in contact with concrete and metals and exhibits excellent adhesion for the joining of brick and tile, glass, concrete, metal, and other materials. For your copy of Bulletin 5-30E which gives complete details, use Reader Service Card.

L—655. Barrel Finishing—A 20-page catalogue, "Advanced Barrel Finishing", has been published by Almco of Albert Lea, Minn. It illustrates and describes the full range of application of this new finishing technique. Disclosed is information that heretofore has not been made publicly available. Many "before and after" pictures are shown, together with modern equipment and full information about abrasive chips and compounds employed. For your copy, write Almco Supersheen, Albert Lea, Minn., and mention PLATING.

L—656. Recording Ammeter and Voltmeter—A 28-page bulletin on its recently announced line of Series 500 Recording Voltmeters and Ammeters has been published by The Bristol Company, Waterbury 20, Conn.

The Bulletin, No. E1111, describes the features of the instruments. Complete information is given about ranges, uses, and specifications for permanent installation and portable use. In addition to a large number of photographs, the bulletin is illustrated with reproductions of charts and actual chart records. For your copy, use Reader Service Card.

L—657. Stainless Steel Pipe—Because nickel and other alloys are in short supply, more and more emphasis is being placed on light-walled Schedule 5 stainless-steel pipe. This new pipe, produced by several mills, recently received the approval of the Correlating Committee of the American Standards Association.

When compared with heavier pipe, such as the well-known Schedule 40, this new pipe schedule provides two or three times

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SALES CLAIMS
CAN SELL
THESE
BRIGHTENERS

as well as a trial in your own plant!

Write today for a specially priced trial order of the ARP Brighteners for any zinc or cadmium plating solution. Or see your Iridite Representative.

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Manufacturers of Iridite Finishes
for Corrosion Resistance and Paint Systems on Non-Ferrous Metals; ARP Plating Chemicals.

BECKMAN—*the leading name in pH—presents another important advancement in instrumentation*

Announcing The BECKMAN MODEL N pH METER

Completely Portable!

Extremely Compact!

. . . and Really Rugged!

In the constantly expanding field of pH, there is wide demand for a *completely portable* battery-operated pH instrument that is low in price, light in weight, compact in size, and amply rugged to be used anywhere—in the orchard, in the oilfields, in textile mills, plating shops, mining and mill operations, food processing plants, laboratories . . . *anywhere*, without dependence upon outside power circuits.

The newly developed Beckman Model N pH Meter not only meets all these requirements, but also many more. Here are the highlights. Check them over. *Never before have unique advantages like these been combined into a single pH instrument!*

OPERATING SIMPLICITY AND ACCURACY . . .

- Accuracy to better than 0.05 pH.
- Low operating cost—less than 2c per hour.
- Built-in temperature compensation—0° to 100° C.
- Fast warm-up—less than 10 seconds.
- "Check Pointer" eliminates need for frequent buffer standardization.
- Batteries are easily checked with the regular panel controls—no need to disassemble the instrument. Clip-mounting of batteries eliminates need for soldering or wiring.

NEW COMPACTNESS AND RUGGEDNESS . . .

- All-metal case—cast aluminum with baked enamel finish to resist wear and corrosion.
- Splash-proof design—fully desiccated internally.
- Shock-proof—each tube is individually shock-mounted.
- Light weight—less than 8 lbs., complete.
- Small, compact—only 4" x 6" x 9½" overall.
- Equipped with the new Beckman Red Label Glass Electrode—virtually unbreakable, covers almost the entire pH range, usable from freezing to boiling.
- By far the most rugged overall construction of any pH meter.

GET ALL THE FACTS on this newest Beckman advancement in pH by contacting your nearest authorized Beckman instrument dealer. Or write direct!

BECKMAN INSTRUMENTS

SOUTH PASADENA 72 CALIFORNIA

Factory Service Branches: Chicago — New York — Los Angeles

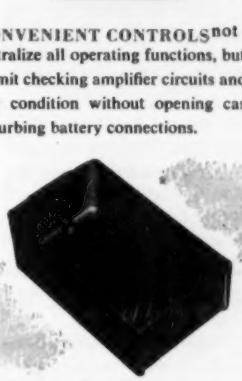
Beckman Instruments include: pH Meters and Electrodes — Spectrophotometers — Automatic Titrators — Radioactivity Meters — and Special Instruments

NEW CONVENIENCE SIMPLICITY RUGGEDNESS

make the Beckman Model N a noteworthy advancement. The following features are typical . . .

ELECTRODE SUPPORT ROTATES alongside case for maximum convenience in carrying. Instrument can be used in either horizontal position (shown at left) or vertical position (above)—whichever is handier.

CONVENIENT CONTROLS not only centralize all operating functions, but also permit checking amplifier circuits and battery condition without opening case or disturbing battery connections.



RUGGED, COMPACT DESIGN withstands rough field and plant service with negligible maintenance. Solid cast-aluminum case is strong, yet light in weight. Beckman Glass Electrode is virtually unbreakable!

There are many other important features designed into the Model N. Be sure to get the *complete* story on this new Beckman development!

ZINC-ALLOY CAMERA CASES are ground satin-smooth with 3M Abrasives at Clarus Camera Co., Minneapolis, Minn.

How the right abrasive boosted belt life 600%

Loading caused by soft metals was limiting production to 40 units per belt at Clarus Camera Co. until the 3M representative recommended the *right* abrasive for the job. Now production has jumped to 240 units per belt!

Are *you* getting maximum production from *your* present abrasives? A 3M representative will be glad to show you how to cut your finishing time, get a smoother surface at a lower cost.

As an additional service, free analysis of your grinding problem is offered at any one of our 13 demonstration rooms—each located in a major industrial area. A 3M Methods Engineer will be glad to help you. Use coupon below.

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St. Paul 6, Minn.

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☐ Please have a 3M Methods Engineer call.
☐ Please send copy of new "Step Up Production" booklet explaining the 3M Method of Grinding and Finishing.

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Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Adhesives. General Export: Minn. Mining & Mfg. Co., International Division, 270 Park Avenue, New York 17, N. Y. In Canada: Minnesota Mining & Mfg. Co. of Canada, Ltd., London, Canada.

Trade Literature

the pipe footage per pound of stainless steel, conserving critical alloys and giving outstanding cost savings. It is satisfactory for the vast majority of applications in industry, providing an excellent margin of safety with working pressures up to 150 psi. In the smaller diameters, below 2-inch OD, working pressures can be considerably higher.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J., has issued a set of data sheets giving pertinent information. For your copy, use Reader Service Card.

L—658. Industrial Management—Now available are the Proceedings of the 14th Annual Time and Motion Study and Management Clinic sponsored by the Industrial Management Society, November 1–3, 1950 at the Sheraton Hotel, Chicago. The 112 pages, including charts, forms, and illustrations, deal with time study, motion economy, methods, plant layout, materials handling, wage incentives, maintenance, and human relations. Published by the Industrial Management Society, 35 E. Wacker Drive, Chicago 1, Ill. Price, $3.00.

L—659. Corrosion of Stainless Tubing—A 16-page "Corrosion Notebook", published by The Carpenter Steel Company, Alloy Tube Division, Union, N. J., contains data on the corrosion resistance of various types of stainless tubing and pipe. In addition to providing data by type of corrodent at various concentrations, the notebook describes general types of corrosion: intergranular, galvanic, atmospheric, and pit type. For your copy, use Reader Service Card.

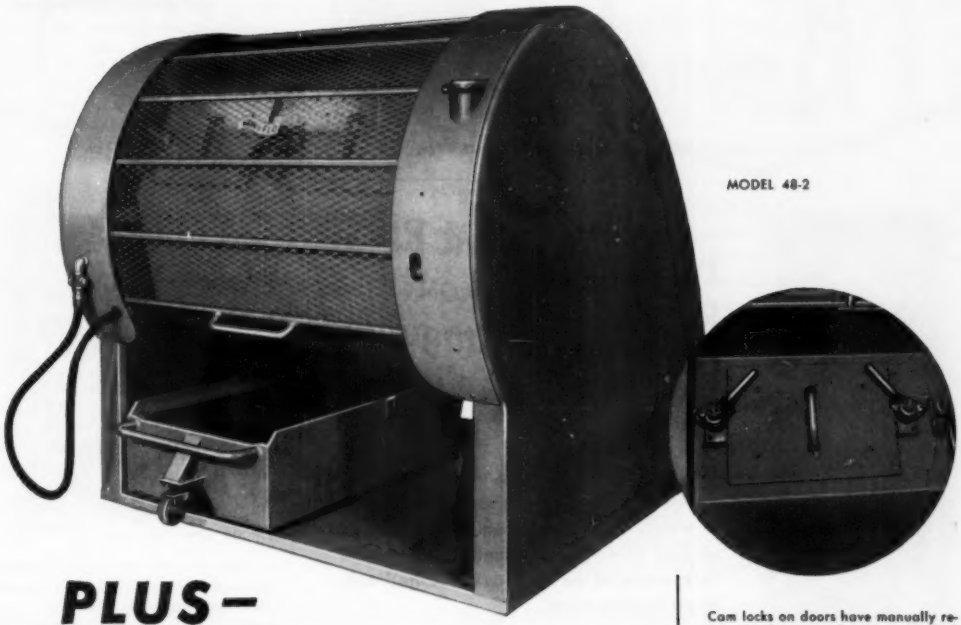
L—660. Metallograph—A very simple but compact, 12 x 12 x 18 inches high instrument, said to be complete with every facility for examining, studying and photographing metal samples and other materials, even large, heavy samples, is illustrated and described in a 4-page bulletin issued by the F. T. Griswold Manufacturing Company, 305 W. Lancaster Ave., Wayne, Pa. Shown are typical microphotographs made by the instrument of hypereutectoid steel samples at magnifications of X400, X1200, X2000 and X3400. For your copy, use Reader Service Card.

EXCELLENT OPPORTUNITY

Sales correspondent and assistant department manager—man, age 25 to 35—college graduate preferred, with chemical background and knowledge of metal finishing—salary open. Reply in writing, giving full information. Cowles Chemical Company, 7016 Euclid Avenue, Cleveland 3, Ohio.

31% to 80% MORE WORK-LOAD-

than comparable tumbling machines occupying the same floor space!



MODEL 48-2

PLUS—

a 15% to 25% shorter cutting cycle!

Grav-i-Flo Tumbling Machines are designed to produce more work in less floor space. That's why so many companies have chosen Grav-i-Flo to handle all their tumbling needs. These manufacturers have compared Grav-i-Flo to other tumbling machinery and have found—First: that Grav-i-Flo machines, in each model, occupying the same floor space, have a 31% to 80% greater capacity; Second: that Grav-i-Flo machines cut from 15% to 25% faster; Third: this shortened processing cycle permits reduction in the required number of machines for an installation, thus benefiting capital investment, floor space and production time; and, Fourth: Grav-i-Flo tumbling machines in all models have such exclusive features as advanced design on door locks and safety guards, and cylinder removal for easier maintenance.

Cam locks on doors have manually released safety stops for pressure relief.

New Grav-i-Flo machines available in a number of models to meet all tumbling requirements. Compartments furnished ½" plate unlined or ¼" plate rubber lined. Reduced voltage control on magnetic starter. Lever or push-button switch. Limit switch on safety guard. 220-440 volt, 3 phase, 60 cycle motor with magnetic brake. Water attachment with hose. Counterbalanced safety guard. Hoist pan has tubular yoke with manually operated lock.

TUMBLE GRAV-I-FLO FINISH

Motor Driven Separator—welded frame supports hoist pan. Separating screen, adjustable from 0" to 1½", accomodates various sizes and types of parts. Screen inclined 5° maximum. Pan shelf provided for stock pan. 1 H.P., 220-440 volt, 3 phase, 60 cycle motor with speed reducer, and manual starter with overload protection.

Samples Processed Free! The Grav-i-Flo Sample Processing Department will gladly tell you how to attain a better finish at lower costs. Send samples direct to The Grav-i-Flo Corporation.

THE GRAV-I-FLO CORPORATION

Dept. P-8, 400 Norwood Ave., Sturgis, Michigan

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 724.

Heat Scale and Rust Removal Without the Use of Dangerous Liquid Acids

Magnus offers a new crystalline acid material—D-Scale-R-S for pickling and derusting of metals. It is a scientifically compounded product of dry, inert chemicals that eliminates many of the hazards associated with liquid pickling acids.

Advantages offered by Magnus D-Scale-R-S

- **Safe to use—non-inflammable and non-explosive.**
- **Eliminates danger of overpickling.**
- **No dangerous handling or storage problem.**
- **Economical to use.**
- **Use hot or cold.**
- **Eliminates acid fog.**
- **More convenient than liquid acids.**

Magnus D-Scale-R-S can be used to advantage whenever sulphuric or muriatic acid is used for removal of scale or rust from metal.

Write for Bulletin No. 36.

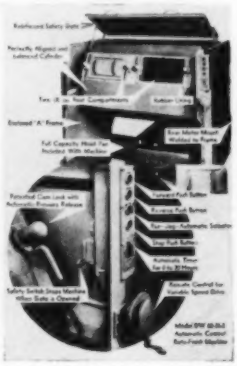
MAGNUS CHEMICAL CO., 41 South Ave., Garwood, N. J.
In Canada—Magnus Chemicals, Ltd., Montreal.
Service representatives in principal cities.

Magnus
CLEANERS • EQUIPMENT • METHODS

816 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 725.

Equipment and Supplies

E—728. Precision Tumbling Machine—Large quantities of parts are precision finished at one time in the Model DW-60-36-2 automatic-control precision-tumbling machine recently developed by the Roto-Finish Company, Kalamazoo, Mich. Features that make its operation more automatic include: compactness and accessibility for speed of operation and maintenance; push-button operation with all controls on one compact panel; jogging provisions and a magnetic reversing starter; automatic timer for processing intervals of 0–20 hours; 5-hp variable-speed power unit with a remote-control handle for adjusting the speed of the cylinder from 10 to 30 rpm.



Safety features are: safety switch that prevents the machine from operating whenever the reinforced safety gate is raised; patented cam locks on the doors, with spring-loaded pressure releases to prevent excessive pressure build-up within the machine; motor mounted on the rear of the machine for safety, motor protection, and ease of maintenance.

Said to be the largest practical standard machine of its type on the market, each of the two compartments has a capacity of 18 cu ft. It is built of 3/16-inch steel. Side supports, motor mount and floor being integral parts of the frame, the machine need not be bolted to the floor of the building. Heavy channel "A" supports are fully enclosed to prevent lodging of chips and to make the machine easier to clean and maintain.

Cylinder shafts are mounted in 2-7/16-inch self-aligning ball-bearing pillow blocks. All cylinders are made in jigs for alignment, and shafts are double supported with gussets and bells. The hoist-pan system of loading and unloading is used. For further information, use Reader Service Card.

The ULTIMATE IN BRIGHTENERS!

ROHCO 20XL FOR CADMIUM

ROHCO 20XL gives cadmium deposits without parallel in brilliance of deposit, uniformity of thickness and covering power. Because barrel solutions may be operated at temperatures up to 105° F., maximum production is maintained. Wide latitude of operable concentration range provides exceptional ease of control. In addition to these many desirable plating properties—the low cost of ROHCO 20XL many times is less than the savings in cadmium metal alone.

ROHCO 100 and 303 FOR ZINC

ROHCO 100 Barrel Brightener imparts brilliance to zinc plating that is almost unbelievable until observed. It exhibits high covering power so that recesses, usually unplated, are easily covered with a substantial thickness of deposit. ROHCO 303 Still Brightener gives unusually bright deposits that offer ideal surfaces for bright dipping to even greater lustre or for conversion coatings by chromic acid treatment. Minimizes consumption of bright dips. Also exhibits high covering power so that recesses are easily plated. The cost of ROHCO 100 and ROHCO 303 is far less than would be anticipated for the many advantages realized in uniformly highest quality, maximum production, and minimum labor costs.

Conversion to ROHCO 20XL, ROHCO 100 or 103 does not entail extra treatment or delay in production

ROHCO

ROHCO PRODUCTS

NO-CRO-MIST • HULL CELL TEST • ROHCO 20XL CADIUM BRIGHTENER ROHCO 100 BARREL AND 303 STILL ZINC BRIGHTENERS • RINS-AID • CRŌMETER

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R. O. HULL & CO., INC.
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Gentlemen:

SEND
- ....Lbs. Powder, ROHCO 20XL CADMIUM BRIGHTENER
- ....Gallons Liquid, ROHCO 20XL CADMIUM BRIGHTENER
- ....Gallons, ROHCO 100 BARREL ZINC BRIGHTENER
- ....Gallons, ROHCO 303 STILL ZINC BRIGHTENER

Name.....
Company.....
Street Address.....
City.....Zone.....State.....

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 725.

Equipment and Supplies

E—729. Chromate Coating for Zinc and Cadmium—Enthone, Inc., Dept. P, 442 Elm St., New Haven, Conn., has announced the development of a new, simplified process for producing chromate coatings on zinc and cadmium. The process is applicable to both zinc plate and zinc-base diecastings. The manufacturer states that the outstanding features are low cost and ease of operation. From 1 to 2 oz of Enthox salts are used per gallon of water. The mixture is operated at room temperature, and after immersion for a few seconds, an adherent, chromate coating is produced. No elaborate means of control are necessary.

The coatings produced are said to meet all existing specifications for chromate coatings on zinc and cadmium. Salt spray resistance on zinc plate is over 200 hours and on cadmium plate over 500 hours.

Various colors can be applied to the coatings by means of suitable dyes: jet black, red, and several other shades of color. The coatings are also said to be excellent bases for organic finishes, including paints, enamels, and lacquers. For further information, use Reader Service Card.

E—730. Derusting and Interim Rust Prevention—The use of Magnus D-Scale-RW for removal of rust without attack on the base metal is illustrated in a report received by the Magnus Chemical Company, Garwood, N. J., on the use of this product in the cleaning of copper-wire spools.

The spools soon lose their original copper plate and rust in varying degree, depending on the care exercised by the wire customers before returning them to the supplier. Formerly, degreased spools were hand brushed on a powered wire brush. Now they are dipped in a solution of Magnus D-Scale-RW at 190° for 3–10 minutes. They are then rinsed in cold running water and dipped into a solution of Magnus 63 that neutralizes any traces of D-Scale-RW which might remain and leave a soap film on the spools. For further information, use Reader Service Card.

E—731. ID Belt Finishing—Inside-diameter grinding, polishing and deburring are said to have been greatly simplified by adaption of the backstand method of coated-abrasive-belt finishing to the Belt Strapping Unit shown here, devised by Behr-Manning Corporation, Troy, N. Y. Easily set up, this unit greatly

reduces the time normally required in ID finishing of such items as forged parachute hardware, scissor and tin-shear eyes, surgical instruments, etc. No shutdown time is involved in threading the coated-abrasive belt through the opening of the piece being finished, as the operator merely releases the belt tension with a foot treadle which allows for belt slippage at the drive unit. Metalite Cloth abrasive belts, available in all grit sizes, produce finishes from rough removal of mold fins to extremely fine finishes required prior to plating. The Belt Strapper is a non-patented development. For further information, use Reader Service Card.

E—732. Surface Coatings in the Tropics—The effects of extreme temperature and humidity on anti-corrosive and fungus-resistant coatings were recently studied during the Isthmian Technical Corrosion and Protection Conference held in the Panama Canal Zone Area, Cristobal and Colon. Highlights of the Conference were an inspection of the Panama Canal Locks at Miraflores, Pedro Miguel and Gatun, and an expedition into the jungles where electronic equipment has undergone outdoor exposure to tropical weather conditions and the presence of jungle life for several years.

According to B. F. Ames, General Sales Manager, Maas & Waldstein Company, Newark, N. J., Chicago and Los Angeles,

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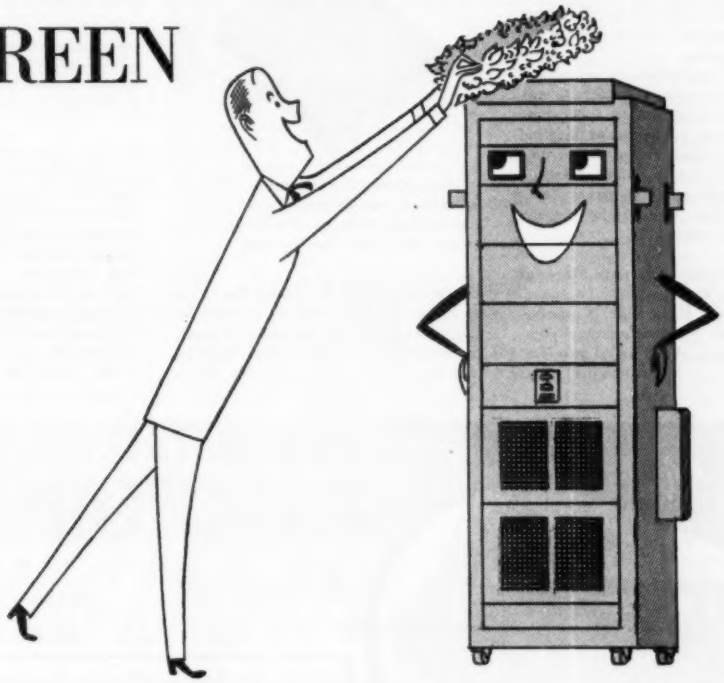
Violets are blue
But the best in rectifiers is GREEN



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RECTIFIER ENGINEERS

Equipment and Supplies

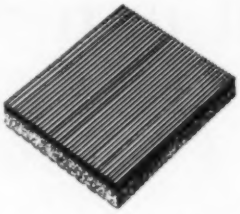
who attended the inspection, his company will now be in a better position to offer fungus-resistant lacquers and synthetic enamels for defense applications. For further information, use Reader Service Card.

E—733. Brushes for Cleaning Small Openings—Walter Borten Company, Furnace Dock Rd., Peekskill, N. Y., manufactures brushes for cleaning parts which hitherto could not be cleaned or maintained properly because of their size and close tolerances.

If specifications, sketch, or actual part are sent to the company, it offers to submit the proper brush for the application. Brushes are made in any size or design of galvanized, stainless, monel, brass, etc., wire of 0.0140-inch or larger diameter, with brush materials of horsehair, goat hair, fiber, Nylon. Write to the company and mention PLATING.

E—734. Burnishing, Drying Material—Agri-Indus Manufacturing Company, 1327 Huntington Bank Bldg., Columbus 15, Ohio, offers "Cocob", a ground corncob product, cleaned and milled into Nos. 10, 20, 40, 60 mesh and specified sizes. It is said to be dust free, uniform, of controlled density of particles, resin and acid free (nonstaining), and highly absorptive. For further information, use Reader Service Card.

E—735. Anti-Fatigue Shop Matting—The Ace Hose & Rubber Company, 1706 S. State St., Chicago, Ill., offers "Lite Step", a combination of a 1/8-inch corrugated rubber top and a ¼-inch live sponge-rubber base.



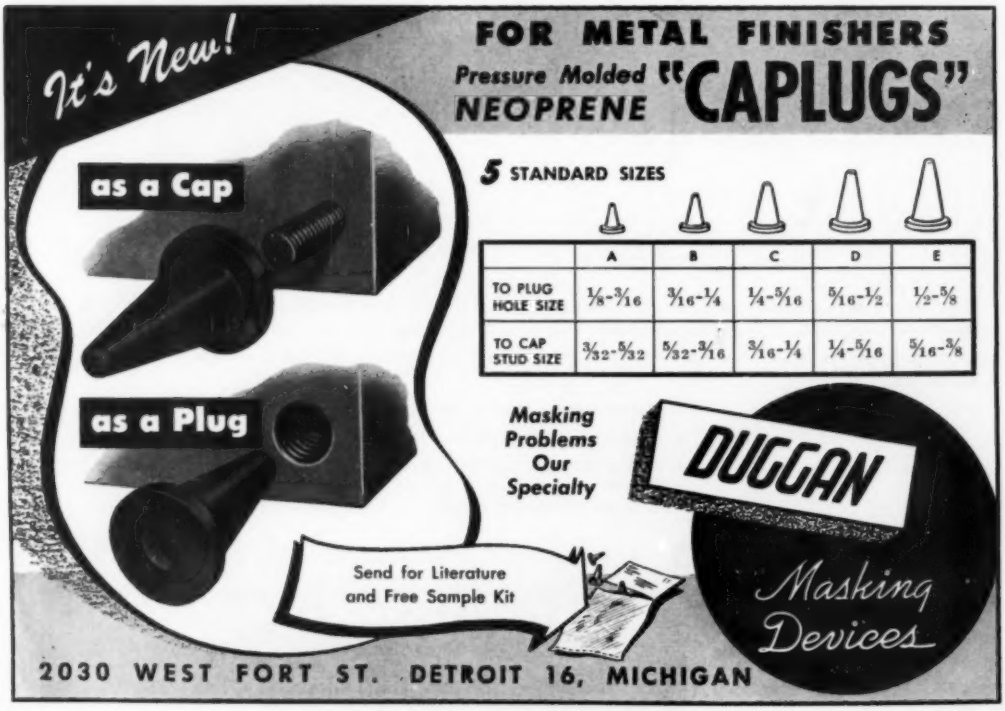
The mat, which comes up to 72 inches in width, is said to give rug-like softness even to concrete floors. For further information, use Reader Service Card.

E—736. Chemical-Resistant Bags—Up to 100 lb of many chemicals can now be shipped and stored in bags made of paper protected by a coating of Bakelite polyethylene resins. Produced by Bemis Brothers Bag Company, 408 Pine St., St. Louis 2, Mo., the bags are said to be economical, easy to print, highly resistant to water vapor, strong and durable. For further information, use Reader Service Card.

E—737. No-Flash-Point Solvent—Colonial Alloys Company, Philadelphia 29, Pa., offers Tetradiene, a no-flash solvent for cleaning, degreasing, etc. It is generally employed at room temperature, although elevated temperatures may be used. It is not intended for vapor degreasing. Drying time is somewhat on the order of that of perchlorethylene.

Tetradiene is said to be less toxic than carbontetrachloride, trichlorethylene or perchlorethylene and relatively stable in storage. For further information, use Reader Service Card.

E—738. Fluid-Abrasive Finishing—Jewett Manufacturing Company, 15614 Hazel Rd., Cleveland 12, Ohio, offers a cleaning and finishing machine which, operating through the medium of a fluid-abrasive blast, is said to save labor cost, time, and space. This process offers a fast and efficient method for finishing drawing, stamping or forming dies and for cleaning all types of aluminum, die-casting zinc, rubber, glass and plastic molds. It provides a finish to which paint



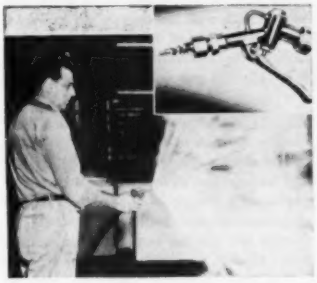
or plating will adhere readily. Buffing and polishing time are said to be reduced, and product appearance is improved.

The operator directs the nozzle from outside the cabinet, working through arm holes. An inspection window provides visibility. Air is regulated by a foot throttle. For further information, use Reader Service Card.

E—739. Two-Phase Emulsion Cleaner—Northwest Chemical Company, 9310 Roselawn Ave., Detroit 4, Mich., offers a cleaning process based on petroleum products to replace hot-chlorinated-solvent degreasing. This system is equivalent to spraying the work with solvent while immersed in water rather than in the air. Since the emulsions are characteristically unstable, mechanical agitation is required to maintain dispersion of the solvent in the water phase.

The two-phase bath is built up of petroleum solvent procured by the user and treated with small proportion of Northwest Addition Agent No. 230. The bath can also be prepared by adding, directly to the water, 10–50 per cent Northwest Emulsion Cleaner No. 3. The baths may be heated to a maximum of 160° F, depending upon the solvent used. Cleaning is always followed by a thorough spray rinse. For further information, use Reader Service Card.

E—740. Fighting Small Factory Fires—A fog "gun" developed by Bete Fog Nozzle, Inc., Greenfield, Mass., is said to make it possible to convert ordinary garden hose into a mobile and effective inside fire-fighting weapon. With the new



gun-type nozzle, a tap pressure of only 30–120 psi will produce an effective fog that will instantly blanket and extinguish small fires: oil, textile, electrical, wood, etc. The nozzle has instantaneous trigger action and a positive shut-off. For further information, use Reader Service Card.

E—741. Dry Acid Pickling Compound—Wyandotte Chemicals Corporation announces the reformulation of a pickling and descaling compound used in water solutions. Readily available, Wyandotte A. E. is said to be nonhazardous, easy to handle, and to give off no obnoxious fumes.

In recent tests, the reformulated product has shown remarkably increased efficiency. Other advantages claimed are controlled foaming characteristics, freedom from dust, elimination of water or acid spotting, close control of pickling, and a simplified waste problem.

The material is a mixture of acids and acid salts combined with a synthetic detergent, in powder form, for replacement of sulfuric and hydrochloric acids in the removal of scale, rust, tarnish, spot-weld marks and flux from brazing operations. For further information, use Reader Service Card.

E—742. Anodizing of Aluminum—Anodizing of aluminum and its alloys has generally been accomplished with the use of motor generators or rectifiers, lead- or rubber-lined tanks, refrigeration and other equipment. Colonial Alloys Company, Philadelphia 29, Pa., now offers a simplified system for anodizing, under government specifications as well as for civilian use, which is said to provide anodizing of high quality at high speed and low operating costs, and with little or no maintenance of electrical equipment.

No license fees or royalties are involved, and chemicals may be purchased in open market. A full-scale production anodizing plant is available for customer's

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study of equipment needs, procedures, the "know how" and "know why" of anodizing. For further information, use Reader Service Card.

E—743. Substitute for Chromium Plate—Metals Disintegrating Company, Elizabeth, N. J., offers an extra-fine aluminum pigment, called MD 769 Aluminum Paste that is said to produce a film of chromium like appearance. Of high brilliance and metallic luster, it is recommended for automotive hardware. Mixtures with the proper vehicle are practically free of agglomerated particles, and the utmost in smoothness and leveling are obtained. This is a leafing-type pigment of 65 per cent nonvolatile content; screen tests show 100 per cent through 325 mesh screen. For further information, use Reader Service Card.

E—744. Polyethylene Tank Liners—Completely welded polyethylene-plastic tank liners, both removable and stationary, are now offered by the American Agile Corporation, Plastics Division, 5806 Hough Ave., Cleveland 3, Ohio. These liners can be furnished in all sizes and shapes with wall thicknesses up to 1-inch and are fabricated entirely of polyethylene to the customer's specifications by the Agile hot-gas-welding method.

Tank liners can be furnished with polyethylene drains and flows, including pipe flanges, fittings and valves.

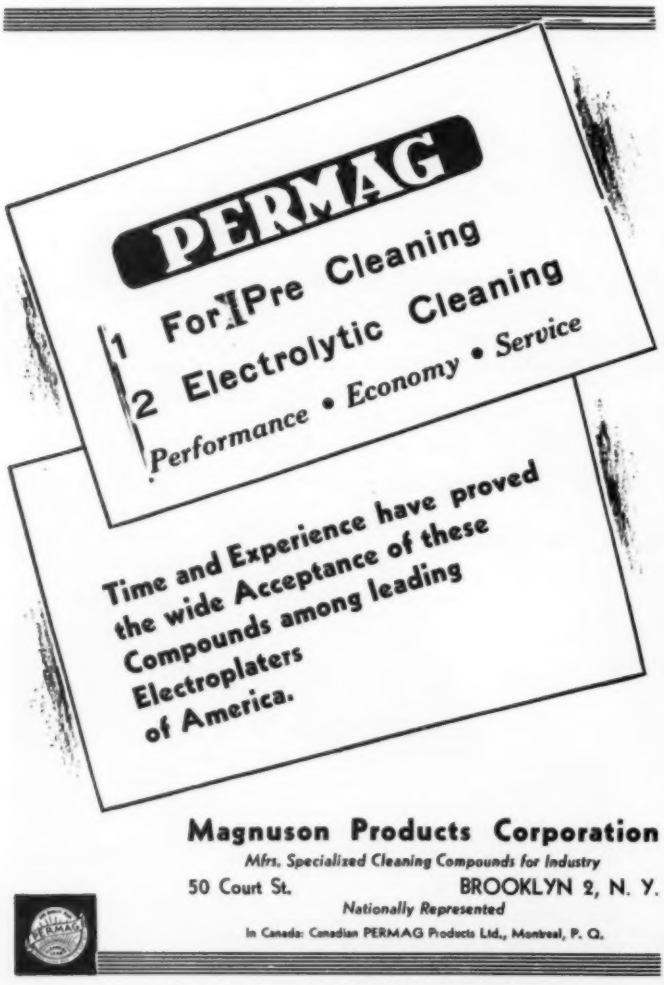
The chemical inertness of polyethylene and the method of fabrication are said to guarantee a leakproof liner and to reduce maintenance and replacement costs of storage and plating tanks containing corrosive liquids.

Complete fabrication may be done at the company's plant in Cleveland or on the site of the installation, depending upon the size and complexity of design. For further information, use Reader Service Card.

E—745. Buff-mounting Press—A hand-operated 20-ton hydraulic arbor press has been introduced by Clair Manufacturing Company, 1016 S. Union St., Olean, N. Y., for mounting buffs on polishing spindles for Clair Surface Finishing Machines. A hollow-ram extension slips over the polishing spindle to exert pressure downwards on the polishing buffs. Offering a ram travel of 5 inches, the design permits the pump and ram to

be removed from the steel framework and used as a portable unit. Dimensions inside the framework are 17¼ x 60 inches. For further information, use Reader Service Card.

E—746. Flooring Compound—An easily brushable, reinforced rubber-base coating material for application to metal, wood or concrete is announced by The Wilbur & Williams Company, Brighton 35, Mass. It is especially recommended for application to stair treads, ramps and floor surfaces where there is danger from slipping under wet conditions. Available colors are tile red, light gray, battleship gray. For further information, use Reader Service Card.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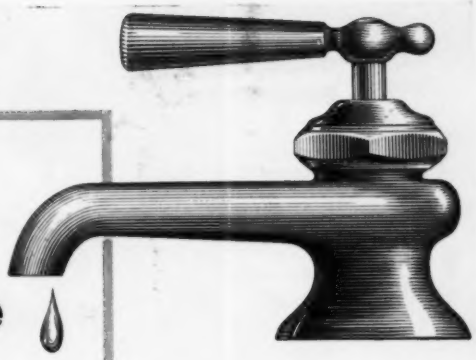

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To us at Apothecaries Hall Company, war-time shortages mean an even greater opportunity to serve you. Faced by short supply of many materials used in the manufacture of AHCOLOID Cleaners, AHCO Buffing Compounds, and 99% NU-CAST Nickel Anodes, we can show you how AHCO knowledge and experience can help keep your finishing room in high gear.

If the specific cleaners or compounds which you are now using become unobtainable, chances are that our chemists can devise an alternate material to do your job satisfactorily. To make sure that your finishing chemicals are "right", our laboratory will analyze them for you. Our trained representatives, working hand-in-hand with your engineers, can help you to get the most from your finishing equipment and materials. This AHCO analytical and engineering service is yours without obligation.

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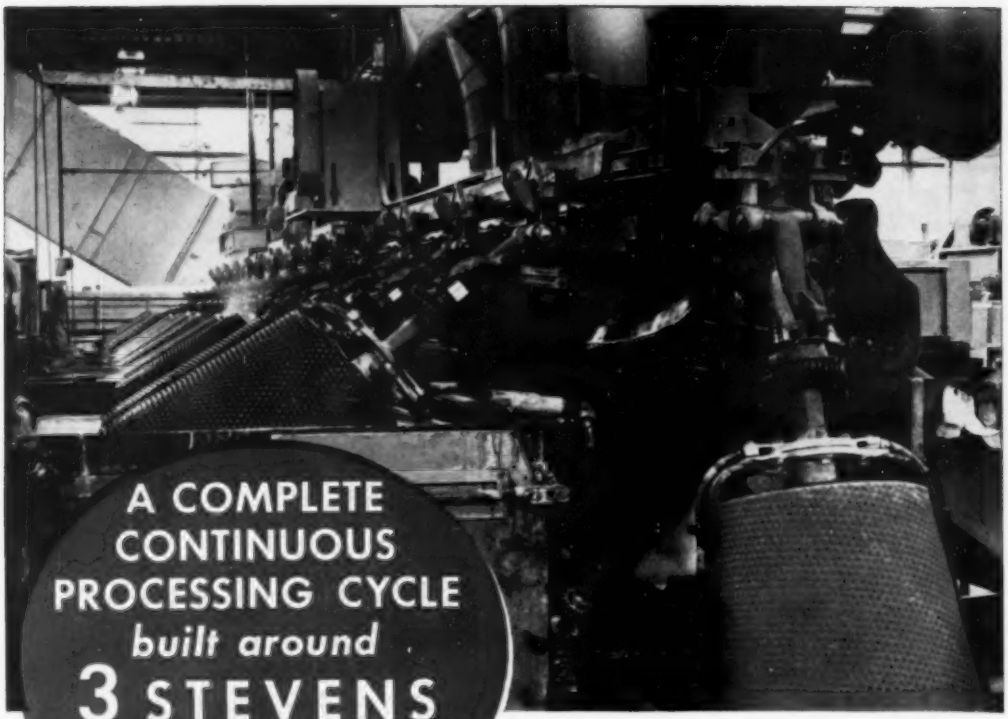

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AUGUST, 1951 VOL. 38, No. 8

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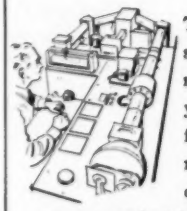

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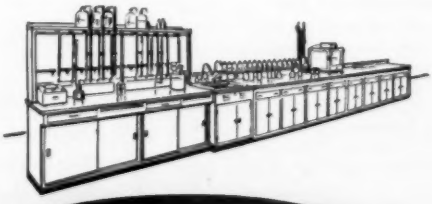

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Editorial

Substitute Finishes

IN A RECENT LETTER to the Editors, W. O. Zinn, President of the National Association of Metal Finishers, the countrywide job-shop owners' organization, raises a question of great importance to the whole plating industry. "How do the substitute finishes now being applied compare with regular nickel-chromium and copper-nickel-chromium coatings, especially in outdoor exposure, and which are the nearest to them in performance"? is his query. He points out that many platers have experimented with these new finishes and that a variety of plate thicknesses, final organic coatings, and techniques of application are being used. He suspects that, performance-wise, some of these combinations will prove entirely unsatisfactory for reasons that do not show immediately in the finish.

One can appreciate the necessity for multiplication of experimental work and for the limited scope of most investigations. Undoubtedly, there is much duplication of effort, but it could not have been avoided under present circumstances. In fact, it may be all to the good, *if* results are compared in some fashion.

The pages of PLATING are open to exchange of experiences in the application of substitute finishes and for reports, however incomplete, on their behavior in the field. Stories of both successes and failures are equally welcome; one can learn from both.

Of much interest would be data showing correlation, within the individual classes of substitute coatings, between results of various laboratory tests—wear tests, salt-spray tests, permeability tests, etc.—and service performance. Such data would be most useful in searches for improved finishes.

Pooling of knowledge has always characterized American industry and has been an important reason for its rapid growth. It is needed now more than ever if the plating industry is to hold its position.

Gustaf Soderberg

MATERIALS OF CONSTRUCTION FOR PICKLING

E. A. TICE

Corrosion Engineer, International Nickel Company, Inc., New York, N. Y.

IN THE FIELD of electroplating one prerequisite for a satisfactory coating is a clean surface on the article to be plated. It is common practice to obtain such a surface by pickling the article in a mineral acid solution. The object of this presentation is to review the subject of corrosion resistant materials, suitable for equipment employed in pickling and bright-dipping operations. Some information is to be found in the literature regarding materials for tank construction and tank linings, but very little information regarding materials for baskets, barrels, and heating coils.

Because the choice of pickling acids employed depends upon the material being pickled, it is necessary to break down this discussion by types of base metals to be pickled.

Iron and Steel

The most commonly used agents for the removal of either rust or scale on cast-iron and steel articles are sulfuric and hydrochloric acids[1]. Hydrofluoric acid may be used for the removal of silica coatings on the surface of sand castings. Sodium acid sulfate solutions may also be used in place of sulfuric acid for the pickling of steel parts.

Sulfuric acid pickling

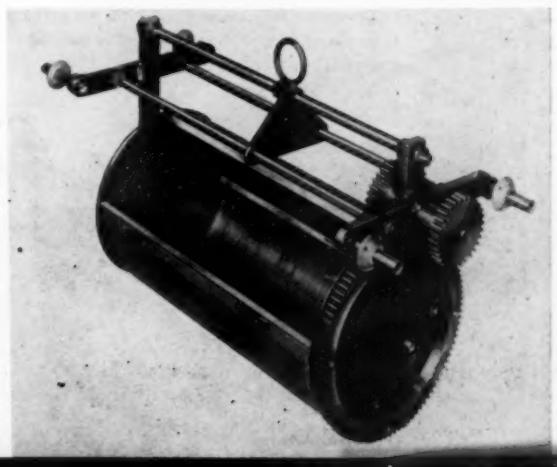
Sulfuric acid and sodium acid sulfate solutions are generally employed in concentrations of from 5 to 15 per cent by weight at temperatures of 140° F (66° C) or higher. Tanks for these solutions are usually made of lead-lined steel, rubber-lined steel, acid-resisting brick, or unlined spruce or yellow pine[2,3]. Wooden tanks are sometimes coated on the inside with asphaltum, more to prevent leakage at joints than for any other reason. Monel* tie rods have been used for many years in wooden-tank construction. Steam heating coils of lead or Monel are useable, lead having better corrosion resistance than Monel particularly where high steam pressure is employed. Where 10 to 15 psi steam is available, extra heavy Monel pipe generally gives economic life for closed steam heating systems. Where open steam heating is desired, steam injectors made of cast 14 per cent silicon-iron alloys, such as Duriron, have proven to be highly corrosion resistant. Steam lines made of lead pipe have been satisfactory for supplying the steam to the injectors.

For barrels, baskets, or hooks to handle steel parts, Monel and acid-resisting bronze have been found to give long life. Monel has been used to a considerable extent inasmuch as it is available in the forms necessary to fabricate baskets and barrels, as shown in Figs. 1 and 2. An automatic pickling machine, operating somewhat like an automatic clothes washer, has recently been developed. Monel has been employed for the parts contacting the pickling acid. This pickler, shown in Fig. 3, is semiportable and should be advantageous for the pickling of large batches of small parts.

*Registered Trade Mark, The International Nickel Company.

Fig. 1. Monel pickling basket which can be revolved over the pickling bath for draining the contents. Courtesy Cambridge Wire Cloth Company, Cambridge, Md.

Fig. 2. Gear driven Monel pickling barrel. Courtesy The Udylite Corporation, Detroit, Mich.



OPERATIONS PRIOR TO ELECTROPLATING

One fabricator makes an all Inconel basket for general-purpose pickling, Fig. 4, which can be used in sulfuric acid and nitric acid, but is not recommended for continual use in hydrochloric acid.

Hydrochloric acid pickling

This acid is generally used at room temperature, diluted 1 part acid to 5 parts water, by volume[1]. Frequently, it is used in higher concentrations, up to 1 to 1. It is not usually heated to the temperature range employed for sulfuric acid, because of its high vapor pressure and because it is active enough at lower temperatures.

Hydrochloric acid is considerably more corrosive to most metals[4] than sulfuric acid, and the choice of useable materials for handling it is more limited. Lead, which is suitable for sulfuric acid picking service, generally forms a soluble lead chloride film, especially in warm or hot hydrochloric acid, and the corrosion rate is usually too high for lead to be economically useable.

Tank linings of synthetic rubber, natural rubber[4], or plasticized polyvinyl chloride resins[5] are suggested. Carbon- or graphite-brick linings[4] can also be used over a wide range of acid concentration and temperature.

Monel has been used for tank service handling up to 10 per cent acid at room temperature. It can be expected to corrode at rather high rates, however, if the bath is aerated, or if the solution is used hot. For such conditions Monel is not recommended as a tank material.

Pickling baskets or barrels of Monel usually give a reasonably long life if they are completely submerged when in use. For barrel service where only a portion of the barrel is immersed, the corrosion takes place under highly aerated conditions and is greatly accelerated. In addition, the barrel tends to receive less galvanic protection from the contents being pickled, when used in this manner. Hastelloy B* is the preferred metal to employ if highly aerated conditions are to be encountered.

Earthenware baskets and rubber- or vinyl resin-covered steel baskets have been used successfully. A recent innovation has been the use of barrels fabricated from methyl methacrylate resins, such as Lucite and Plexiglass.

Hydrofluoric Acid

As mentioned above, the principal use of hydrofluoric acid pickling is for the removal of sand from iron castings. Blum and Hogaboom[1] suggest a 2-*N* (4 per cent by wt) solution, and plant corrosion tests have been conducted in both 6 and 10 per cent solutions[6]. In a 6 per cent solution at 170° F (77° C), a 28-day test indicated that copper, silicon bronze, and Monel all had a very low corrosion rate.

Monel crates are currently being used for service in

*Haynes Stellite Company, Kokomo, Ind.

Fig. 3. Automatic pickling machine. Courtesy American Machine & Solvents Company, New York City

Fig 4. General purpose Inconel pickling basket. Courtesy Rolock, Inc., Fairfield, Conn.

one plant for handling cast-iron parts prior to the application of a zinc coating. One precaution in the use of Monel in this service should be pointed out. The reaction of silica with hydrofluoric acid causes fluosilicic acid to form. In the highly stressed condition, Monel will suffer stress corrosion cracking by fluosilicic acid. Therefore, cold-rolled or cold-drawn Monel shapes should not be employed. Annealed material, however, has been found satisfactory.

Copper Base Alloys

Pickling

The removal of oxides from the surface of copper base alloys is usually accomplished in a dilute solution of sulfuric acid or in a mixture of sulfuric acid and sodium dichromate. Sulfuric acid solutions of about 10 per cent (by wt) or less are commonly used at temperatures of 125–175° F (52–79° C). With use, the solution builds up in copper sulfate content, which acts as a good inhibitor of corrosion for the stainless steels. As a precautionary measure in making up a new bath, some copper sulfate is usually added to insure against attack of the stainless steel. The dichromates, being good oxidizing agents, also inhibit the corrosion of the stainless steels in sulfuric acid solutions. Consequently, the austenitic stainless steels (18–8 Cr-Ni types) can be successfully used for both tanks and pickling baskets, with the molybdenum-modified type 316 being more reliable where drastic conditions are encountered, as in processes involving extra high temperature, e. g., over 150° F (66° C). Where welding is required for the fabrication of the equipment, a stabilized grade of stainless steel or one containing less than 0.03 per cent carbon should be employed to preclude accelerated corrosion in the heat-affected zones adjacent to welds. The extra-low-carbon 18–8 and types 347 and 321 stainless steel which contain stabilizing elements are generally satisfactory for tanks and baskets. For steam-heating-coil service, type 316 stainless steel is preferred, because it has higher resistance to corrosion at the higher temperature. Lead coils may also be employed.

One plating shop, employing a woven-wire basket for the pickling of relatively small parts, found that the wires were corroding badly in a region about two-thirds the way up the side. Upon investigation it was found that an unstabilized grade of stainless was being used, and in order to hasten the drying of the parts, the pickling operator usually passed a torch over the basket in this area after removal from the water rinse. The heating effect of the torch had apparently been sufficient to cause carbide precipitation in this

TABLE I. PLANT CORROSION TESTS IN PICKLING OF BRASS AND COPPER

Test 1: Specimens immersed near center side of pickling tank in 5 per cent sulfuric acid plus 0.5 oz/gal (4 g/l) copper as copper sulfate. Solution heated and agitated with live steam. Temperature 80–85° C (175–185° F). Duration of test 30 days.

Test 2: Specimens immersed in pickling tank in 19–28 per cent sulfuric acid plus 2–4 per cent copper sulfate during flash pickling of brass parts. Temperature 60° C (140° F). Duration of test 41 days.

Test 3: Specimens immersed in pickling tank during continuous pickling of oxidized copper sheet in 20 per cent sulfuric acid plus up to 5 per cent copper sulfate. Tank drained and refilled four times during test. Temperature 60–71° C (140–160° F). Duration of test 25 days.

Test 4: Specimens exposed in spray-pickling machine to spray of 10 per cent sulfuric acid plus 2 per cent copper sulfate. Aerated by spraying. Temperature 32° C (90° F). Duration of test 176 hours.

Material	Corrosion Rate, inch per year			
	Test 1	Test 2	Test 3	Test 4
Monel	0.036	0.005	0.024	0.090
Nickel	[x]	.....	0.052[b]	0.086
Inconel	0.055	0.046	0.086	0.0001
Worthite	0.0003	.....	0.002	0.0001
Durimet 20	0.0005	.....	0.006	.....
Hastelloy B	0.074[a]	.....	.....	.....
Hastelloy C	0.002	0.002	.....	.....
Hastelloy D	.....	0.070	.....	0.072
Ni-Resist (Type 1)	.....	.....	.....	0.62
Mild steel	.....	.....	.....	[y]
Cast iron	.....	.....	.....	1.54
Chemical lead	.....	.....	0.005	0.003
18–8 Mo stainless (Type 316)	0.0001	0.0001	0.014	0.0001

[a] Perforated by localized corrosion. Original thickness of specimens 0.037 inch (0.94 mm)
[b] Pitted to maximum depth of 0.009 inch (23 mm) during test
[x] Completely corroded away before end of test. Original thickness of specimens 0.031 inch (0.79 mm)
[y] Completely corroded away before end of test. Original thickness of specimens 0.062 inch (1.57 mm).

area of the stainless steel basket, which resulted in considerably lowered corrosion resistance of this metal when immersed in the pickling acid. If a stabilized grade of stainless had been used, this attack would not have occurred.

The suitability of Monel for copper pickling service depends upon whether oxidizing or reducing conditions prevail. In an unaerated sulfuric acid bath, Monel usually has fairly high corrosion resistance. If the bath is aerated, or if a dichromate is present, the oxidizing conditions prevailing greatly accelerate the corrosion of Monel, and it is not recommended for such service.

The results of corrosion tests for a number of metals and alloys in pickling solutions for copper and brass are shown in Table I. These data illustrate the above-mentioned effects on Monel and type 316 stainless steel.

Bright dipping

In bright-dip solutions, oxidizing salts, such as dichromates or nitrates, or nitric acid, are usually added to sulfuric acid. Small amounts of hydrochloric acid may also be present. The exact composition depends upon the alloy being treated and the type of surface desired. Examples of such bright dips are:

Constituent	Formula A[7] g/l	Formula B[8] lb
H_2SO_4	800	30.8
HNO_3	100	11
HCl	2.5	1/32
H_2O	491	2

Results of some plant corrosion tests in the bright pickling of brass parts are shown in Table II. Because conditions are quite oxidizing in nature, Monel, lead, and the acid-resisting bronzes are not generally suitable. Inconel, the stainless steels, and such nickel-chromium-molybdenum-iron alloys as Worthite and the Durimets usually exhibit excellent corrosion resistance as long as oxidizing conditions prevail. Inconel and other chromium-nickel alloys are generally useable for dipping baskets, the nickel-chromium-molybdenum-iron alloys for pumps and valves, and type 316 stainless for tank construction. The elimination of crevices in tank construction is important to avoid localized crevice corrosion, because if the oxidizing agents become depleted in the crevice area a breakdown of the passive film may occur, and serious attack in the crevice results. Such attack on type 316 stainless steel is illustrated by the data in Table II, tests 3 and 4.

TABLE II. PLANT CORROSION TESTS IN BRIGHT PICKLING OF BRASS

Test 1: Specimens immersed 6–12 inches below minimum liquid level in pickling tank during pickling of brass in 7–8 per cent sulfuric acid plus 0.8–0.9 oz/gal (6-7g/l) sodium nitrate. Solution agitated with plunger. Temperature 69–74° C (155–165° F). Duration of test 13 days.

Test 2: Specimens immersed in pickling tank during pickling of brass in 23 per cent sulfuric acid and 18 per cent nitric acid. Temperature 66–82° C (150–180° F). Duration of test 31 days.

Test 3: Specimens immersed near center side of pickling tank during bright dipping of brass in 5 per cent sulfuric acid plus 1.1 oz/gal (8 g/l)sodium bichromate. Temperature 21–30° C (70–85° F). Duration of test 30 days.

Test 4: Specimens immersed near center side of pickling tank during pickling of brass in 10 per cent ferric sulfate solution plus 0.5 per cent citric acid. Solution heated and agitated with live steam. Temperature 77–99° C (170–210° F). Duration of test 38 days.

Material	Corrosion Rate, inch per year			
	Test 1	Test 2	Test 3	Test 4
Monel	0.37	.....	x	x
Nickel	x	.....	0.0002[a]	0.043[c]
Inconel	x	0.0005	0.0004[b]	0.0004[a]
Worthite	.....	.....	0.0001	0.0001
Durimet 20	.....	.....	0.0001	0.0001
Aloyco 20	.....	0.0001	.....	.....
Durimet T	0.0001	.....	.....	.....
Hastelloy B	.....	.....	y	y
Hastelloy C	0.002	0.0002	0.0001	0.0005
Illium R	.....	0.0001	.....	.....
Chemical lead	0.052	.....	.....	.....
18–8 Mo stainless (Type 316)	0.0001	.....	0.0001[d]	0.0001[d]

[a]Pitted to maximum depth of 0.010 inch (0.25 mm) in crevice under insulating spacer.
[b]Perforated by pitting in crevice under insulating spacer. Original thickness 0.031 inch (0.79 mm)
[c]Perforated by pitting on free surface and in crevice. Original thickness 0.031 inch (0.79 mm)
[d]Perforated by pitting under insulating spacer. Original thickness 0.031 inch (0.79 mm)
[x]Completely corroded away before end of test. Original thickness of specimens 0.031 inch (0.79 mm)
[y]Completely corroded away before end of test. Original thickness of specimens 0.037 inch (0.94 mm)

Aluminum and Its Alloys

A bright etch finish for aluminum is produced by immersion in a hot alkaline solution, such as 2–8 oz/gal sodium hydroxide, sodium carbonate, or trisodium phosphate. Steel equipment satisfactorily withstands these alkaline solutions, and highly alloyed materials are not required. However, if the etching period is sufficiently long, a smut will develop on the surface, and an acid dip is necessary to remove the smut.

The smut may be removed either in a sulfuric-nitric acid solution, such as the bright dip for copper alloys, or in a dilute nitric-hydrofluoric acid solution as follows:

Hydrofluoric acid	1 part by vol
Nitric acid	1 part by vol
Water	98 parts by vol

For the latter, vinyl-resin tank linings have been reported to be satisfactory, but the writer is not familiar with any installations of uncoated alloys. In the field of pickling stainless steels, nitric-hydrofluoric acid mixtures of higher concentrations are used, and recent experience has indicated that the extra-low-carbon type 316 stainless steel has a tolerable corrosion rate at temperatures up to 140° F (60° C), even in the as-welded condition. Thus, it would seem logical that this material, as well as Inconel, might be useable for service in the more dilute acid mixture, for either baskets or tanks or for both.

Aluminum castings containing silicon usually require a much stronger bath, and the following mixture is used at room temperature:

Nitric acid	3 parts by vol
Hydrofluoric acid	1 part by vol

This mixture is quite corrosive, and tanks are usually lined with either carbon brick or certain organic linings. Koroseal appears to be a highly satisfactory material, and flame-sprayed polyethylene coatings have considerable promise.

Dipping baskets of stainless steel or of nickel-chromium alloys are used, but do expend themselves due to corrosion. Such plastics as methyl methacrylate appear to have promise and may prove to be the best materials for basket service.

Magnesium

The removal of oxide from magnesium prior to surface treatment or electroplating is generally considered a step in the cleaning process, following an alkaline treatment. Diggin and Foulke[9] suggest three pickles:

1. Chromic acid-calcium nitrate solution, used warm
2. Dilute sulfuric acid, at room temperature
3. Dilute nitric-sulfuric acid, at room temperature

For the chromic acid solution tank they suggest lead-lined steel, stainless steel, or 2S aluminum. For sulfuric acid they list ceramic containers, rubber- or lead-lined steel tanks, and for the dilute nitric-sulfuric acid solution, ceramic containers or stainless steel (type 347 or equivalent NE steel) tanks.

In a patented plating process developed by the Dow Chemical Company, a pickling bath of 20 per cent acetic acid plus 5 per cent sodium nitrate is employed for wrought products, and a 75–80 per cent phosphoric acid bath for cast products. Ceramic or rubber-lined-steel tanks are suggested for both of these solutions.

Zinc Base Alloys

Zinc-base diecastings make up the greatest proportion of zinc-base alloys which are being plated with metallic coatings. Because most of these castings are buffed in the process of preparation for plating, pickling, in the usual sense, is not a necessary preplating step. Prior to copper plating, however, a sulfuric acid dip is employed, the acid concentration ranging from 1–4 per cent by volume. The tank materials employed for higher sulfuric acid concentrations are useable for this service, and Monel or stainless-steel baskets are suitable.

If the zinc-base articles have been stored for an appreciable time and have developed a white zinc-corrosion product, this coating may be removed in a strong chromic acid solution containing a small amount of sodium sulfate, operated at room temperature. Steel or stainless-steel tanks and baskets are reported[10] to be satisfactory for this service.

Summary

Many factors, controlled by operating practice, affect the overall life of pickling equipment. Some of these factors have been briefly mentioned above. If the electroplater will freely discuss his pickling practice with the fabricator, the materials supplier, and the corrosion engineer, the effects of these factors may be assessed, and the choice of suitable materials may be simplified.

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THIS ARTICLE

describes the effect of particle size and concentration on the properties of suspensions. The mechanisms for separation used in various types of filtration—mechanical blocking, collision and adhesion, and electrical attraction—are discussed. The more important variables affecting power consumption in filters are the properties of the fluid being filtered, the dimensions and structure of the filter bed, and the pressure drop across the bed.

PRINCIPLES OF FILTRATION

B. W. WILSON*

I. Introduction

Filtration can be defined as the separation of solid particles from a fluid. It is effected by passing a suspension through a medium which retains the solid, but allows free passage of the fluid. A typical example of filtration, and one incidentally based on the method used for the clarification of wine in ancient times, is illustrated in Fig. 1. Here a capillary siphon filter has been set up with two beakers and a strand of cotton wool, and a nickel plating solution is clarified on passing from one beaker to the other through the cotton wool strip. In fact, the use of wool or felt in this type of filter is believed to have supplied the word filtration from the Latin word "feltrum", meaning compressed wool or hair.

Methods and materials have changed considerably since early times, but the fundamental principles remain the same, and any modern filter system, for either liquids or gases, can be reduced to the same three elements. Reference to the model shows that these are, in their logical sequence, as follows:

1. A suspension
2. A filtering medium
3. A source of energy

What follows is a brief introduction to the principles of filtration based on this analysis.

II. The Properties of Suspensions

The practical man's main interest in suspensions is his ability to filter them. To be able to think in terms of what actually takes place during filtration, and possibly to predict the best conditions of separation, it is helpful to know some of the more fundamental properties of suspensions.

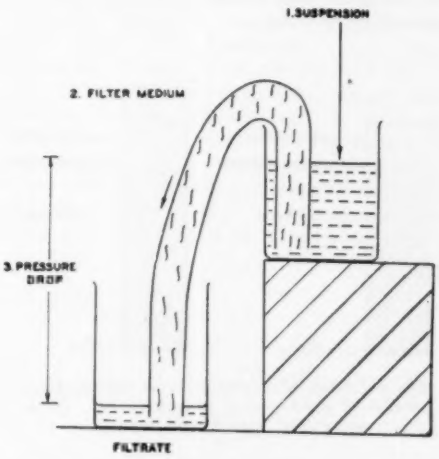

Fig. 1. A capillary siphon filter illustrating fundamental principles of filtration

*An Officer of the Division of Industrial Chemistry, Commonwealth Scientific and Industrial Research Organization, Australia.

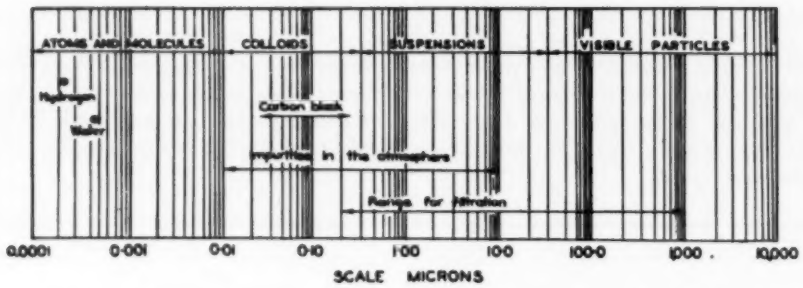

Fig. 2. Particle-size spectrum. Note that the carbon black referred to has a smaller particle size than the activated carbon used for purification of plating solutions

Particle size

First, and most important of all, is particle size. A dirty plating bath can be regarded as a complicated mixture of particles ranging from atoms up to the large masses visible to the naked eye. An attempt has been made in Fig. 2 to illustrate this diagrammatically by what is known as a particle-size spectrum. The unit of length used to designate the approximate diameter of particles is here the micron, or one-thousandth of a millimeter. At the left hand end of the scale we have the atoms or ions which make up the fluid portion of the solution, and which pass through all types of filter media. Next we might mention the molecules of the air above the suspension and the molecules of substances dissolved in the solution. From simple molecules we pass to particles consisting of large numbers of atoms or molecules which are termed colloids; these also pass filters. Finally, beyond the colloidal range, we come to microscopic particles ranging from 0.1 micron upwards, which can be separated by filtration.

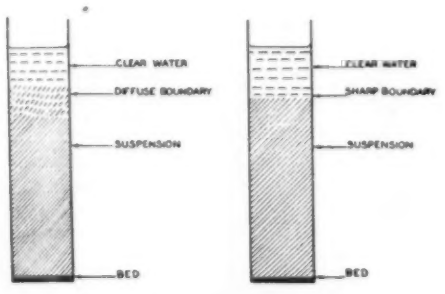

Fig. 3. Effect of concentration on nature of suspension of glass spheres in water. Left, 10 per cent solids; right, 15 per cent solids

Concentration

Closely related to particle size is another property of suspensions, namely, the concentration or number of particles in a given volume of the suspension. Different concentrations of the same solid in the same fluid give rise to suspensions of quite dissimilar properties. This has been illustrated in the bench-demonstration model shown in Fig. 3. Here two suspensions of microscopic spheres in water have been shaken and allowed to settle. Comparing these examples, we find that the left-hand one, containing 10 per cent by volume of spheres, settles and leaves behind a diffuse cloud of spheres on the upper surface of the suspension, whereas the other, containing 15 per cent by volume, settles with a layer of clear water above a sharp upper boundary. In the first cell, the properties of the suspension depend on the behaviour of individual particles, but in the second, the concentration has exceeded a critical value, and the properties of the suspension depend on the collective properties of a large number of particles. The exact reason for this is complex and will not be discussed, but the phenomenon serves to illustrate the existence of two types of suspension depending on concentration.

In filtration, a division in practice already exists according to the concentration of the particles, the filtration of dilute suspensions, or "clarification", requiring different treatment than the filtration of concentrated suspensions, or "cake filtration". In clarification, the problem is essentially one of separating individual particles, and it is characteristic to find that some of the particles are readily removed whereas others tend to pass through the filter. The performance of a clarification filter, particularly in the case of gases, is such that only the larger particles are removed. On the other hand, in concentrated suspensions, the particles separate collectively in the form of a cake, and the separation is usually complete*.

*In plating practice, clarification is primarily involved when a plating solution is filtered continuously during operation, which is customary when electrolytic purification and heating by outside heat exchanger is used. Usually, clarification filtration is also encountered when a freshly made bath is filtered or salts are dissolved for purpose of solution maintenance. With this type of filtration, an adequate precoat of filter-aid is of utmost importance in order to insure retention of fine particles, and especially retention of the activated carbon which may be used in conjunction with the operation.

Cake filtration is normally used in plating practice only when high-pH purification has been carried out.—A. K. Graham.

III. The Mechanism of Filtration

The wide variation in the properties of suspensions, particularly in particle size and concentration, makes it necessary to consider a number of mechanisms for separation which will be described as: (1) mechanical blocking, (2) collision and adhesion, and (3) electrical attraction.

Mechanical blocking

If a suspension is passed through a wire screen or a woven cloth, solid particles, too big to fit inside the openings, are retained. For dilute suspensions, one selects a medium with holes smaller than the particles to be separated, and when all the holes are blocked, the filter has to be cleaned or replaced.

For concentrated suspensions, the situation is somewhat different. Thus if we take a suspension in water of glass spheres 0.100 mm in diameter, containing 20 per cent by volume of solids, and apply suction to a capillary 0.300 mm in diameter immersed in it, the capillary quickly becomes blocked by a tightly packed

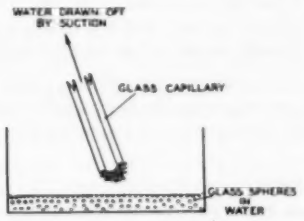

Fig. 4. Blocking of 0.3-mm capillary by 0.1-mm spheres in 20 per cent suspension

bridge, or dome, of spheres, with very few entering the capillary (Fig. 4). Hixon, Work and Odell[1] have studied the conditions for the formation of these blockages and have found a definite ratio between the pore diameter and the size of particle at which blockage takes place. Fig. 5 illustrates how this ratio increases as particle size decreases.

Collision and adhesion

Because the preparation of filter media with pores sufficiently fine is difficult and because the power consumed in forcing the filtrate through the pores is high, the mechanism of mechanical blocking is usually limited to suspensions with comparatively large particles or to suspensions containing a high concentration of solids.

For the clarification of very dilute suspensions of microscopic particles, quite a different mechanism has to be employed. Thus, if a suspension is passed rapidly through a thick pad or bed of fibrous materials, a degree of separation takes place inside the bed which is not of the simple blocking type, because the passages

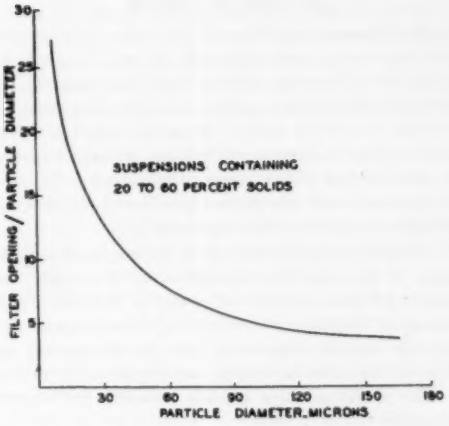

Fig. 5. Effect of particle size on the ratio of pore diameter to particle size at which blockage takes place

are usually much larger than the diameter of the particles. Here the mechanism is one of collision, or impact. The filter medium may be considered as a series of obstacles arranged in depth in the path of a rapidly moving suspension of particles. The gaseous or liquid part of the suspension passes around the obstacle, but some of the particles tend to move straight on because of their greater inertia, and they eventually collide with the obstacle. Also, if conditions are favorable at the surface of the obstruction the particles may adhere to the obstacle after collision. The efficiency of separation in a filtration of this type, which we propose to call a "labyrinth" type filter, depends on the dynamics of the collision process and on factors which determine the adhesion of the particle after collision.

Some of the variables which control the process of collision can be studied by reference to an ideal model, such as a suspension of spherical particles flowing over a cylinder. Fig. 6 shows a section through the cylinder with solid stream lines indicating the flow of the fluid and broken lines indicating the path of particles which tend to move out of the stream lines to collide

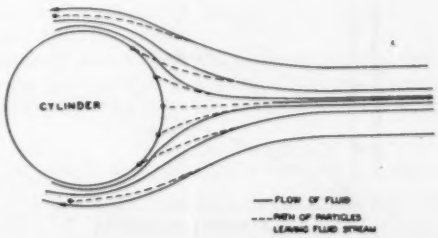

Fig. 6. Flow a fluid bearing spherical particles and separation of the particles by collision with a cylinder in the path of the flow

with the cylinder. The mechanism of collision may be further demonstrated by a model where the cylinder is in motion and the suspension at rest. A small glass sphere of ¼-inch diameter is suspended from the ceiling by a long thread so that it is just immersed in a shallow trough of water. A metal cylinder with its axis vertical is then moved rapidly through the water in the direction of the sphere. Depending on the speed of approach and the relative position of the sphere, a collision, or a near miss, can happen.

A mathematical treatment of the mechanism of this type of filtration has been given by Langmuir[2], but many difficulties stand in the way of the direct application of this theory to filtration. The trend of some of the variables, however, can be recognized, and some of the more interesting conclusions are as follows:

The likelihood of a particle colliding with an obstruction will be greater

(1) the closer the particle diameter approaches the width of the obstruction, i. e., the diameter of cylinder
(2) the higher the velocity of the particle as the obstruction is approached
(3) the denser the particle
(4) the more the obstacle tends towards a certain shape.

Fig. 7 shows the relative efficiency of several differently shaped obstructions.

Electrical attraction

Once a particle has collided with an obstruction, some attractive force must be present if it is not to be deflected back into the fluid stream. For large particles in gases, a layer of oil or viscous material may serve to catch the particles. Alternatively, a highly irregular surface on the material forming a labyrinth may have "dead" regions where there is no motion, and the particles will remain trapped. For the most part, forces exist on the surface of particles, and the material used to construct the labyrinth tends to retain the particles.

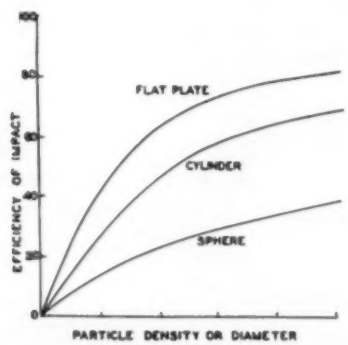

Fig. 7. Relative efficiency of variously shaped obstructions in causing collision by particles

For gas suspensions, these forces are due to electrostatic attraction, and it has been demonstrated that impregnation of a filter with substances promoting an electrostatic charge greatly improves the separating efficiency. Electrical attraction based on a somewhat different phenomenon takes place in liquid filtrations, but beyond the fact that some materials have better separating properties than others, little is known at present of their effect on the mechanism of filtration.

IV. The Application of Power

An analysis of the separating mechanisms used in various types of filtration shows that the familiar engineering problem of fluid friction must be overcome. To make fluids flow through filter media or filter cakes, power has to be supplied to create the necessary pressure drop, and the amount of pressure drop depends on the method of filtration. In this respect it should be pointed out that the energy required for the actual separation is only a very small part of the total amount, which is largely expended on particles already separated on the filter medium.

Some of the methods for reducing power consumption to a minimum can be best appreciated by reference to the various types of separating mechanism.

Blocking filters

In filters based on the blocking mechanism, power is expended mainly on the particles blocking the openings in the filter media and in the layers of particles which accumulate during filtration. Except for the filtration of comparatively large particles, the blocking mechanism finds its chief application in cake-type filtrations, where the bridging effect described previously enables the pores to be kept relatively large and the power consumed in the medium low.

Cake filtration has been widely investigated from the point of view of power consumption, because of its wide application, and considerable technical information is available[2,4,5]. Here we propose to discuss only the more important variables, namely (1) the structure of the filter bed, (2) the properties of the fluid being filtered, (3) the dimensions of the filter bed, and (4) the pressure drop across the filter bed.

The structure of the bed depends ultimately on the nature of the particles (their fineness) and on the closeness of packing. Because particle size varies widely, power requirements must be capable of substantial variation. In practice, the power required may increase up to four times for a 50 per cent decrease in particle size.

Next to particle size in its influence on the structure of the bed comes the closeness of packing of the particles. Whereas this may be defined between closer

limits than particle size, its effect is quite large. For example, if we consider two beds, one with a porosity, or ratio of free space to total volume, of 50 per cent and the other of 90 per cent, and if both have the same particle size, the flow through the second bed will be some twenty times that through the first bed for the same power input. Porosity is a factor which can be controlled, and it is one of the chief variables to watch in carrying out a filtration.

Compared to bed-structure variables the other variables in cake filtration, although easy to change, have considerably less effect on power consumption. For example, the *viscosity of the fluid* may be varied by changing the temperature, the power being reduced by an increase in temperature for liquids and by a decrease in the temperature for gases. The power consumption can also be decreased by increasing the *area of the filter medium* or decreasing the thickness within certain practical limits imposed by the cost of the filter medium and its supporting structure.

Finally, there is the *pressure drop across the filter*. It is true that an increase in pressure drop usually speeds a filtration, but from the point of view of power requirements the effect may be detrimental. In many cases, excess pressure causes a collapse of the bed or cake, and the resulting change in the porosity may have a serious effect on the power consumed.

Many examples of filtration can be quoted where pressure drops are extremely low, particularly in the case of gas filters where the efficiency of fans and blowers imposes an upper limit considerably less than in the case of liquid separations. Beyond a certain point, the pressure drop only becomes a source of power loss, and the old pressure-type filters have in many cases given way to vacuum filters operating at approximately one atmosphere or less.

Labyrinth filters

In the labyrinth-type filter, the power expended is used to overcome the resistance to fluid flow in the filter medium, and only in the final stages, when the filter begins to become blocked, does it become limited by the accumulation of particles already separated.

The variables controlling labyrinth-type filters are essentially the same as those controlling the flow in beds or cakes. In fact, a great deal of study of the properties of filters originated from a desire to know more about fluid flow in beds of sand used as labyrinths in water purification. Here we can choose, for the labyrinth, materials with particle size and porosity to give a minimum power consumption for a given separating efficiency. Also, it is possible to select materials which do not compress or change in porosity under pressure.

Filter aids.—The most effective material for liquid clarification is a processed type of diatomaceous earth which is available in various grades, the best having a very high porosity and extremely low resistance to liquid flow. In addition, the separating efficiency is high because of the irregular shape of the particles and their highly sculptured surfaces.

Fibre pads.—Next to diatomaceous earths, pads of textile fibres make efficient labyrinths. Once again, a high porosity gives good flow conditions, and the nature of the surface of the textile fibre influences the efficiency of separation.

Other mechanisms

In all mechanisms where separation is effected by surface forces, most of the power is consumed in forcing the fluid through a labyrinth, and only in extreme cases of filtration, such as in the electrostatic precipitator, is the energy consumed applied directly to the particles.

V. Conclusions

With the aid of a simple model filter, the fundamental principles of filtration have been outlined on a broad basis for both liquid and gas suspensions, and for clarification as well as cake-type filtration. At a later date, it is intended to publish further details of the mechanism of filtration based on a unified concept being developed as part of the research program of the Division of Industrial Chemistry of the C.S.I.R.O.

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TENTATIVE RECOMMENDED PRACTICE FOR

PREPARATION OF AND PLATING ON STAINLESS STEEL[1]

A. S. T. M. Designation: B254–51 T, Issued 1951[2]

This Tentative Recommended Practice has been approved by the sponsoring committee and accepted by the Society in accordance with established procedures, for use pending adoption as standard. Suggestions for revisions should be addressed to the Society at 1916 Race Street, Philadelphia 3, Pa. which also supplies reprints.

Scope

1. (*a*) Various metals are electrodeposited on stainless steel for such purposes as color matching, lubrication during cold heading, spring-coiling, and wire-drawing operations, reduction of scaling at high temperatures, improvement of wettability (as in fountain pens), improvement of heat and electrical conductance, prevention of galling, jewelry decoration, and staving off superficial rusting where appearance is important.

(*b*) This recommended practice is presented as an aid to electroplaters and finish engineers, who, although familiar with electrodeposition practices on common metals, are confronted with new problems inherent in the electrodeposition of metals on stainless steel. It is not intended as a standardized procedure but merely as a guide to the production of smooth adherent electrodeposits on stainless steel.

Nature of Stainless Steel

2. (*a*) Because previous metal treatment may have a more pronounced effect on the final finish when stainless steel is being plated than when other metals are being plated, the metal finisher should become acquainted with the fabrication procedure, grade, and mill finish of the stainless steel with which he is working before outlining his electrodeposition procedure.

(*b*) The surface of stainless steel presents a unique phenomenon in that it is normally resistant to a wide variety of corrosive elements. This property has been attributed to the presence of a thin transparent film of oxides. Since this film reappears after it has been stripped off or penetrated, it fortifies the entire body of metal against attack by many destructive agents. It is impractical to obtain an adherent electrodeposit over this film. However, once this film is removed (the surface activated) and kept from reforming until the surface has been covered with an electrodeposit, any of the common metals may be electrodeposited successfully on stainless steel. Various methods for scale removal are described in the Appendix.

(*c*) Where the finished product is to be subjected to service exposure, the deposit produced by the proposed plating sequence should be tested under similar exposure conditions before adoption, to determine whether the natural corrosion resistance of the stainless steel has been impaired by the presence of the electrodeposit (Note).

Note.—In the jewelry industry a thin undercoat of nickel before a thin deposit of gold or chromium has been found to reduce severely the corrosion resistance of the stainless steel. A nickel undercoat for silver plating has been reported to give satisfactory corrosion resistance.

Nature of Cleaning

3. (*a*) The preparation of stainless steel for plating involves three basic steps in the following order:

(*1*) Removal of scale by one of the methods outlined in the Appendix,

(*2*) Removal of oil, grease, or other foreign material by cleaning (Note 1), and

(*3*) Activation immediately before plating.

(*b*) *Precleaning.*—Removal of fabricating lubricants and finishing compounds from the stainless steel may have to be undertaken immediately following the fabrication or finishing operation (Note 2).

(*c*) *Electrocleaning.*—Anodic cleaning is generally preferred (Note 3).

(*d*) *Metal Lubricants.*—Metal lubricants such as copper, lead, or cadmium, applied to stainless steel wire for cold heading, wire drawing, or spring forming or by contamination, are removed by immersion in a solution of nitric acid (20 per cent by volume) at 120 to 140° F (49 to 60° C).

[1] Under the standardization procedure of the American Society for Testing Materials, this recommended practice is under the jurisdiction of the A. S. T. M. Committee B-8 on Electrodeposited Metallic Coatings.

[2] By publication of these specifications, the American Society for Testing Materials does not undertake to insure anyone utilizing the specifications against liability for infringement of Letters Patent nor assume any such liability, and such publication, with certain patent references or the absence of a patent reference, should not be construed as a recommendation of any patented or proprietary application that may be involved or as an expression of opinion of any member of the Society as to the validity of such patents.

NOTE 1.—Oil, grease or other fabricating lubricants should be removed by cleaning prior to heat treating.

NOTE 2.—Spray cleaning with a nozzle pressure of 30 to 60 psi (2.1–4.2 kg/cm²) in a power washer, using alkali or emulsion-type cleaner, is the generally preferred method, especially for the removal of heavy drawing, buffing, or polishing compounds. Soak cleaning or vapor degreasing may also be used. Extreme examples of such compounds are drawing or stamping lubricants containing unsaturated oils, which if left on the surface, form by air-oxidation tenacious films that are very difficult to remove.

NOTE 3.—When brightness is important, alkalinity, current density and temperature should be kept as low as the part will permit. This is an essential requirement when cleaning work on racks bearing auxiliary lead anodes or when high chromium alloys (such as types 442 and 446) are being cleaned.

CLEANING SOLUTIONS

4. Solution control, electrodes, heating coils, and rinse tanks normally used for cleaning carbon steel are satisfactory for stainless steel.

RACKING

5. The general principles of good racking as used in chromium plating processes apply. However, the high electrical resistance of stainless steel requires rack construction methods that are more precise (Note).

NOTE.—Because of the high electrical resistance of stainless steel, especially in fine-coiled wire articles such as watchbands, chains, jewelry, etc., it is necessary to provide a larger number of contacts. As an example, a watch band 4½ inches (11 cm) long made of 0.045-inch (0.011-cm) diameter wire has been found to require at least three contacts.

ACTIVATION

6. (*a*) After the cleaning operation and prior to the plating operation, the parts must be completely activated, that is, the thin transparent film of oxides must be removed from the surface to be plated (Note). This film will reform if the parts are allowed to dry or are exposed to oxygen-containing solutions. For this reason, the shortest interval practicable should elapse between the time the parts are removed from the activating solution and covered by the electrodeposit, unless a simultaneous activation-plating procedure is used.

NOTE.—When an electrodeposit is used functionally, the etching practice should be of a more severe type than that used for decorative chromium plating.

(*b*) The following activating procedures have been used. The procedure selected will depend upon the nature of the part and preceding or subsequent processes (Paragraph (*f*)). In the following solution formulas, the concentrations are expressed on a volume basis as follows:

Liquids	ounces per gallon refers to fluid ounces
Solids	ounces per gallon refers to avoirdupois ounces

Sulfuric acid (oil of vitriol)	commercial grade of 66° Baumé acid (sp gr 1.83) (93 per cent H_2SO_4)
Hydrochloric acid (muriatic acid)	commercial grade of 20° Baumé acid (sp gr 1.16) (31 per cent HCl)
Nickel chloride	commercial grade having the formula $NiCl_2 \cdot 6H_2O$
Copper sulfate (cupric sulfate) (blue stone)	commercial grade having the formula $CuSO_4 \cdot 5H_2O$

(*c*) *Cathodic Treatments:*

(*1*) Sulfuric acid	5 to 50 per cent
Temperature	room
Time	1 to 5 min
Cathodic current	5 amp per sq ft (0.5 amp/dm²)
(*2*) [a]Hydrochloric acid	5 to 50 per cent
Temperature	room
Time	1 to 5 min
Cathodic current	20 amp per sq ft (2.2 amp/dm²)
(*3*) Immerson in hydrochloric acid	10 to 30 per cent
Temperature	room
Followed by cathodic treatment in:	
Sulfuric acid	5 to 50 per cent
Temperature	room
Current density	5 to 25 amp per sq ft (0.5–2.7 amp/dm²)

(*d*) *Immersion Treatments:*

(*1*) Immerse in a 20 to 50 per cent solution of sulfuric acid at 150 to 180° F (66 to 82° C) (with the higher temperature for the lower concentration) for at least 1 min after gassing starts. If gassing does not start within 1 min after the parts have been immersed, touch them with a carbon-steel bar or rod. This procedure is applicable to all standard grades of stainless steel wire. This activation treatment will produce a dark, adherent smut which is removed in the plating bath. A cathodic current of at least 5 amp per sq ft (0.5 amp/dm²) may be used to accelerate activation. Lead anodes are suitable for this solution.

(*2*) Immerse in:

Hydrochloric acid	0.1 per cent
Sulfuric acid	1.0 per cent
Temperature	room
Time	26 sec

NOTE.—This method has been used with success for chromium plating on stainless steel automobile parts in a conveyorized process.

(*e*) *Simultaneous Activation—Plating Treatments:*

(*1*) [b]Nickel chloride	32 oz per gal (240 g/l)
Hydrochloric acid	11 oz per gal (82.5 g/l)
Iron	0.75 per cent, max
Temperature	room
Electrodes	nickel

[a]See U. S. Patent No. 2,133,996.
[b]See U. S. Patents Nos. 2,285,548-9.

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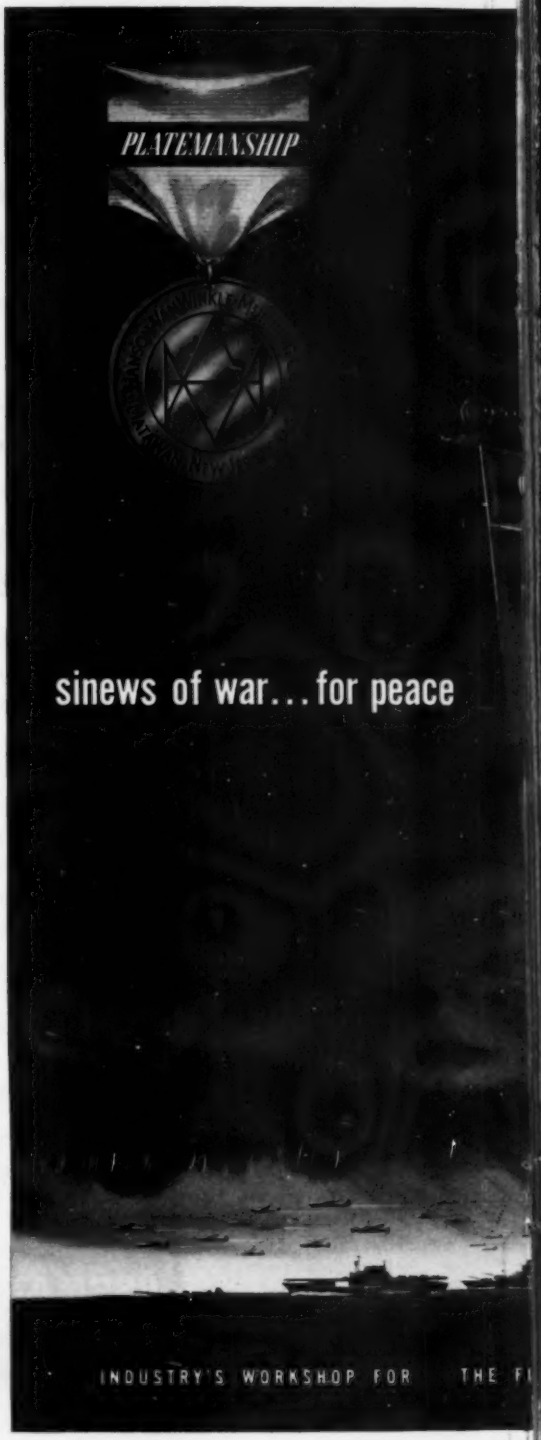
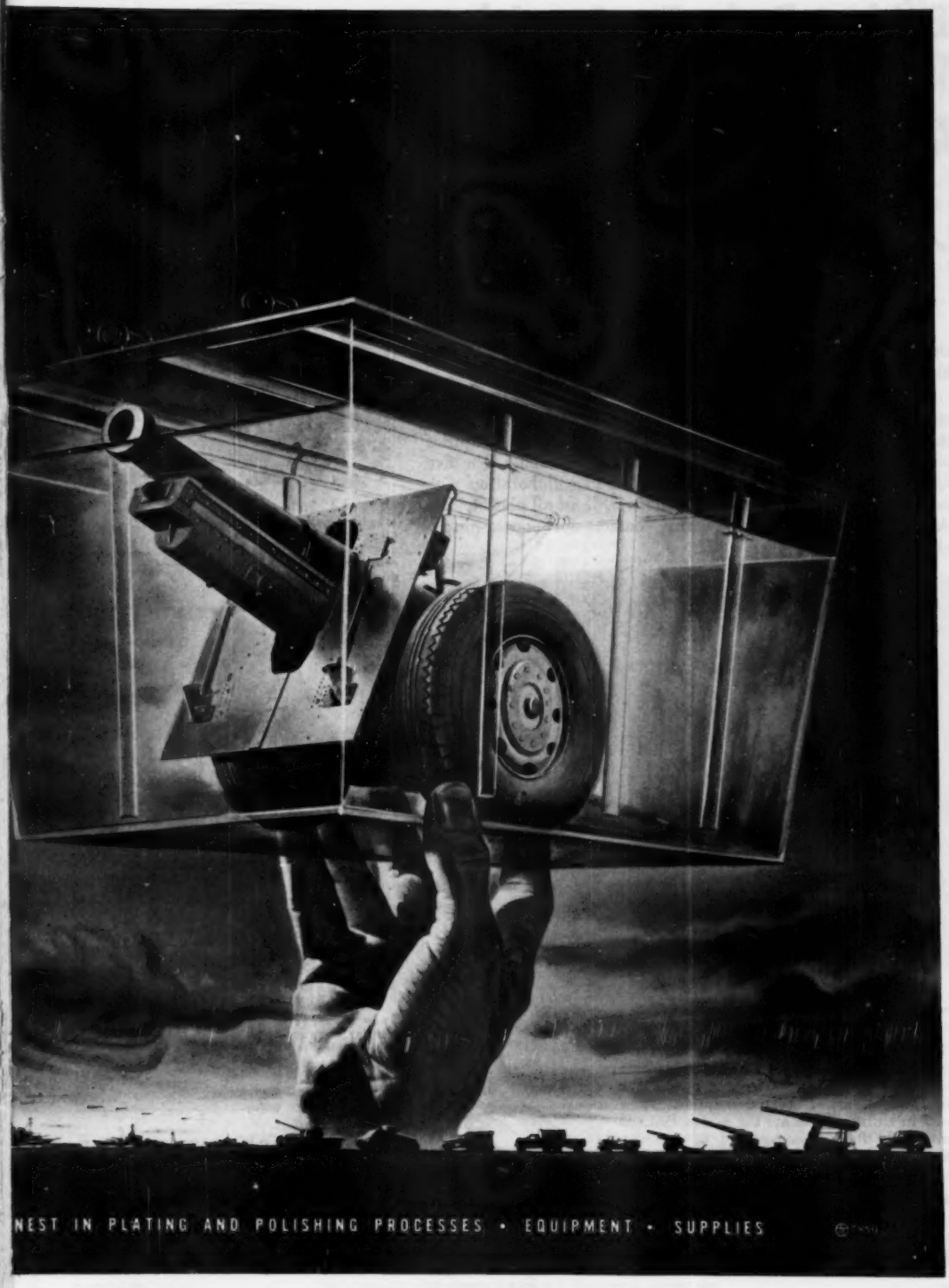
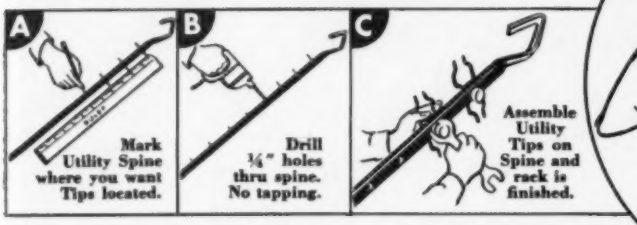



NEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

Efficient Racks For Any Job In A Matter of Minutes


A
Mark Utility Spine where you want Tips located.
B
Drill ¼" holes thru spine. No tapping.
C
Assemble Utility Tips on Spine and rack is finished.

With a supply of *BELKE Utility Spines and Tips* on hand, it's that simple—that fast—that easy to have *complete racks* designed for your job, whether chrome or any other plating.

Universal Plastic Coating on Utility Spines and Tips withstands all cleaning and plating cycles. You space Utility Tips the way you want them. They join the spine with a leakproof seal, yet are easily changed or respaced on the spine. The five Utility Tip models have been developed in collaboration with experienced platers to efficiently handle 90% of all plating jobs. All models have spring pressure contacts for copper-nickel-chrome plating.

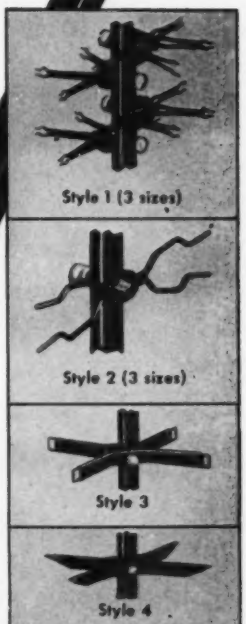
BELKE VAC-SEAL REMOVABLE TIP DESIGN

Flexible, Cup-like Collar of Universal Plastic is forced against spine coating, forming a leak-proof union. (pats. pend.)
Spines and Tips Coated with Universal Plastic. Withstands all plating cycles.
Drill ¼" hole thru coated spine. No tapping. Will not injure coating.
Tapered Nut tightens against spine metal to support tip, assuring positive contact. (pats. pend.)
Knurled Shank is drawn into spine metal. Tips cannot twist or turn. Positive contact is assured. (pats. pend.)
Threaded Lucite Cap encloses nut. (pats. pend.)

BELKE UTILITY SPINES

$2.85 ea.

30" and 36" lengths. Fabricated from ¼" x ⅝" round-edge copper stock with thick coating of BELKE Universal Plastic.



FIVE UTILITY TIP STYLES

Only 4 most popular shown. Other styles to specifications. All styles coated with Universal Plastic.

Plating Rack Economy Never Before Equalled

BELKE Utility Racks give tremendous service life. The Removable, Interchangeable Tips enable you to use them over and over again on countless jobs of every description. When holes in Utility Spines are not in use, BELKE Removable Plugs can be used to seal out solutions.

What's more, BELKE Utility Racks cost you half as much as specially designed racks.

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EVERYTHING FOR PLATING PLANTS

ANODIC TREATMENT

Current density	20 amp per sq ft (2.2 amp/dm²)
Time	2 min

FOLLOWED BY CATHODIC TREATMENT

Current density	20 amp per sq ft (2.2 amp/dm²)
Time	6 min

(2) [a]Nickel chloride	32 oz per gal (240 g/l)
Hydrochloric acid	16 oz per gal (120 g/l)
Electrodes	nickel
Temperature	room[b]
Current density (cathodic)	50 to 200 amp per sq ft (5.4–22 amp/dm²)
Time	2 to 4 min

FOLLOWED BY

Current density (cathodic)	15 to 50 amp per sq ft (1.6–5.4 amp/dm²)
Time	15 to 30 min

(3) Nickel chloride	4 to 40 oz per gal (30 to 300 g/l)
Hydrochloric acid	2 to 20 oz per gal (15 to 150 g/l)
Electrodes	nickel
Temperature	room
Current density	5 to 100 amp per sq ft (0.5–10.7 amp/dm²)
Time	½ to 5 min

(4) Hydrochloric acid	concentrated
Copper sulfate	0.05 oz per gal (0.4 g/l)
Electrodes	nickel
Temperature	room
Current density	40 to 60 amp per sq ft (4.3–6.5 amp/dm²)
Time	1 to 5 min

(*f*) A combination of more than one type of treatment may be necessary to insure a high degree of adhesion. The following example has been used in the automotive industry for nickel plating on 18 Cr-8 Ni stainless steel:

Sulfuric acid	65 per cent (52° Baumé)
Volts (cathodic)	10
Electrodes	lead
Temperature	room
Time	2 min

FOLLOWED BY

Nickel chloride	32 oz per gal (240 g/l)
Hydrochloric acid	12 per cent (1.2 *N*)
Electrodes	nickel
Temperature	room
Time	2 min
Current density (cathodic)	150 amp per sq ft (17 amp/dm²)

This is followed by transfer without rinsing to a Watts (or higher chloride) nickel bath at a *p*H of 1.5 to 2.0.

RINSING

7. The parts should be transferred to the cold water rinse and to the plating solution as rapidly as practicable after the activating procedure; otherwise the surface will passivate itself, and the electrodeposit will not be adherent.

(*a*) The rinse water should be kept slightly acid (approximately *p*H 2.5 to 3.5). The acid carryover from the activation operation will maintain this *p*H in many instances.

(*b*) In conveyorized operations where trace contaminations of chlorides and sulfates in plating solutions will produce an unsatisfactory electrodeposit, spray-rinse operations subsequent to the activation treatment will remove these contaminants.

(*c*) If the simultaneous activation-plating procedure is employed and nickel plating follows, the intermediate rinse need only be superficial, and the length of transfer time is not so important.

PLATING

8. (*a*) An adherent plate of the common metals (cadmium, copper, brass, chromium, gold, nickel, or silver) may be electrodeposited directly on stainless steel provided the surface of the stainless steel is active (Notes 1, 2, and 3).

NOTE 1.—Nickel may be electrodeposited at normal current densities directly on stainless steel from standard nickel-plating solutions if the *p*H of the solution is between 2 and 4.. A *p*H of 2 is preferred.

NOTE 2.—When a chromium-plating solution containing 53 oz of CrO_3 per gal (400 g/l) is used for decorative chromium plating, better coverage and a wider bright range is obtained by operating at a current density of 150 amp per sq ft (16 amp/dm²) and 120° F (49° C).

NOTE 3.—A bright nickel plate under chromium, preceded by one of the simultaneous activation-plating treatments, may often be used to advantage for better color matching and elimination of chromium buffing.

(*b*) Where practical, the parts should have the current applied when they are immersed in the plating solution.

STRIPPING

9. (*a*) Nitric acid is the preferred stripping solution.

(*b*) Decorative chromium plate has been stripped in a 50 per cent hydrochloric acid solution at 115 to 120° F (45 to 49° C) for 1 min (Note). Overstripping will result in etching.

NOTE.—Decorative chromium plate may also be stripped anodically in a solution of an alkaline cleaner compound.

(*c*) Cadmium is stripped successfully without current by immersion in a solution of 16 oz of ammonium nitrate per gallon (120 g/l).

POST-PLATING OPERATIONS

10. Post-plating operations such, as stress relieving, buffing or coloring, and forming or drawing, may be applied to stainless steel the same as to any other basis metal as long as the natural differences in the

[a]See U. S. Patent No. 2,437,409.
[b]Bath may require cooling or reduction in hydrochloric acid content if temperature exceeds 90° F.

characteristic of the stainless steel are taken into consideration. The stainless steel supplier should be consulted for guidance in regard to these characteristics.

Methods of Testing

11. The methods of testing for thickness, hardness, and adhesion of electrodeposits on the usual basis metals may be employed for similar tests on stainless steel (Note).

Note.—An exception to this is in determining the thickness of chromium on stainless steel by the hydrochloric acid drop method. Since gassing continues after the chromium coating has been penetrated, the accuracy of this method may be questionable for this application.

APPENDIX

Stainless Steel Grades, Mill Finishes, Condition for Electrodeposition, Effect of Fabrication and Methods of Scale Removal

Grades of Stainless Steel:

A1. (*a*) There are more than 20 standard grades and many more special grades of stainless steel. Each grade has a specific use, and each may present an individual finishing problem.

(*b*) The common grades are classified as:

(*1*) *Group I, Martensitic*, or hardenable, magnetic chromium grades. AISI types Nos. 403, 405, 406, 410, 414, 416, 420, 431, 440A, 440B, and 440C are the more common alloys of this grade.

(*2*) *Group II, Ferritic*, or nonhardenable, magnetic chromium grades. AISI types Nos. 430, 430F and 446 are the more common alloys of this type.

(*3*) *Group III, Austenitic*, or nonhardenable, nonmagnetic chromium-nickel alloys. AISI types Nos. 301, 302, 303, 304, 305, 308, 309, 310, 316, 317, 321 and 347 are the more common alloys of this type.

Mill Finishes:

A2. Stainless steels can be obtained with a variety of finishes.

(*a*) *Bar and Wire Stock.*—The common finishes applied to bar and wire stock are:

(*1*) Hot rolled (scale present),
(*2*) Hot rolled and pickled (scale removed),
(*3*) Rough turned (round bars only),
(*4*) Cold drawn,
(*5*) Centerless ground (round stock only), and
(*6*) Polished (round stock only).

(*b*) *Sheet Stock.*—The common finishes applied to sheet stock are:

Finish	Description
No. 1	Hot rolled, annealed and pickled (white pickled finish)
No. 2B	Bright full cold-rolled finish
No. 2D	Dull full cold-rolled finish
No. 4	Standard polish (bright finish with fine polishing lines)
No. 6	Standard polish tampico finish (soft luster, satin finish)
No. 7	High luster polish (glossy, bright, buffed finish)

Condition of Stainless Steel for Electrodeposition:

A3. All of the common grades of stainless steel with normal heat treatments, in the full range of hardness, and in the forms mentioned above, with any surface finish free of scale, and when properly activated may be covered with electrodeposits of the common metals (Notes 1, 2, and 3).

Note 1.—The best corrosion resistance is exhibited by martensitic grades in the hardened and stress-relieved condition, by the ferritic grades in the process-annealed condition, and by the austenitic grades in the annealed condition.

Note 2.—The smoothness of the stainless steel surface to be plated should be comparable with the requirement of the finished product. Grinding checks, glazing, and heat-treating stains on the stainless steel should be avoided.

Note 3.—The high carbon grades (AISI types 420, 440A, 440B and 440C) may be subject to hydrogen embrittlement during plating operations. This may be overcome by heating the plated articles at 300 to 500° F (150–260° C) for 1 to 3 hr after plating.

Fabrication:

A4. Stainless steel alloys are susceptible to improper fabricating procedures in forming or heat-treating practices; therefore, an investigation of difficulties encountered in producing an adherent deposit on stainless steel should start with the procedures used for fabrication. Technical assistance for such investigations is furnished by the suppliers of stainless steel. Their assistance may often be helpful in planning for plating on stainless steel.

Scale Removal:

A5. Scale on stainless steel as the result of heat treatment during or subsequent to fabrication or forging must be completely removed to obtain satisfactory adhesion of the electrodeposit. The scale formed on stainless steels is generally tenacious and may be somewhat more difficult to remove than scale on carbon steel. Two basic methods are used: mechanical methods, such as sandblasting and tumbling, or chemical methods, such as pickling in acid solutions or in molten salts.

(*a*) *Blasting.*—This treatment serves to break up the hard scale and render it more responsive to pickling operations. The scale that usually develops on the martensitic and ferritic grades because of high annealing temperatures and long annealing cycles can be broken up only by sandblasting.

(*1*) Air-driven or rotary-impelled iron-free sand, stainless steel shot or aluminum oxide grit may be used. Ordinary steel shot, turkish emery, natural corundum, and other iron-containing abrasives are undesirable because they are likely to imbed rust-producing iron in the surfaces being processed. Fragments, deburred particles, or other fines must be kept out of the blasting medium. The operation must be controlled very carefully, and the force of the blasting stream must be kept diffused to prevent unevenness of the surface.

(*2*) Blasting is not usually employed on products made of sheet, strip, or tubing.

(*3*) Even if all scale has apparently been removed, it is necessary to pickle the parts.

(*b*) *Shot Peening or Wheel Abrading.*—This cold-working process may also be used for scale removal.

(*c*) *Tumbling.*—This far gentler method of scale removal is generally used on parts that have been stamped, machined, or drawn to a practically completed shape.

(*d*) *Wet Tumbling.*—This procedure is considered effective. A final finish approaching that of a color-buffed finish may be obtained by the proper selection of abrasive, speed of rotation, and time. The tumbling media should be completely removed if the parts are to be stored in a humid atmosphere 24 hr or more prior to activation. A 20 to 40 per cent by volume solution of nitric acid (40° Baumé) operated at 120 to 140° F (49 to 60° C), followed by a cold water rinse, will effectively remove the tumbling media.

(*e*) *Pickling.*—This procedure usually follows preliminary scale removal by other means.

(*1*) The scale formed on stainless steel during forging, heat treating, welding, and other high-temperature processing will vary greatly with the grade and heat-treating environment. If it is heavy, blasting or shot peening before pickling will prove economical and time-saving because it will remove much of the brittle scale and crack the underlying layers, thus affording a more uniform removal in the pickling baths.

(*2*) Chromium grades of Groups I and II (Section A1) are the more difficult to pickle. Full annealing of these alloys causes a very tight scale to develop that usually requires blasting to break. Sandblasting should always be followed by pickling to remove mill scale or particles of iron imbedded in the surface.

(*3*) One recommended procedure for pickling consists of two steps: scale softening and partial removal in sulfuric or hydrochloric acid, followed by final scale removal and whitening in a nitric-hydrofluoric acid solution. In the following solution formulas, the concentrations are expressed on a volume basis as follows:

Sulfuric acid (oil of vitriol)	commercial grade of 66° Baumé acid (sp gr 1.83) (93 per cent H_2SO_4)
Hydrochloric acid (muriatic acid).....	commercial grade of 20° Baumé acid (sp gr 1.16) (31 per cent HCl)
Nitric acid (aqua fortis)....	commercial grade of 40° Baumé acid (sp gr 1.38) (63 per cent HNO_3)
Hydrofluoric acid (phthoric acid).....	commercial grade of 52 per cent acid (sp gr 1.20) (24° Baumé)

(*a*) The first step employs 8 to 11 per cent sulfuric acid at 150 to 160° F (66 to 71° C) in a wood, ceramic, or lead-lined tank for 10 to 45 min or a 10 to 15 per cent solution of hydrochloric acid at 120 to 140° F (49 to 60° C) in a wood or rubber-lined tank for 30 to 90 min. A suitable inhibitor should be used, and the parts should be rinsed thoroughly before they are advanced to the second step.

(*b*) The second step consists of immersion in a solution of 6 to 10 per cent of nitric acid containing 1½ per cent of hydrofluoric acid at room temperature for 10 to 30 min, or until the smut has been removed. The time required for the Group III grades (except the free-machining 18Cr-8Ni grade, type 303) may be shortened by the use of a 10 per cent solution of nitric acid to which has been added 1½ per cent hydrofluoric acid at 140 to 160° F (60 to 71° C) until the smut has been removed. This latter method should not be used on the martensitic or ferritic grades nor on AISI type 303 austenitic stainless steel.

(*4*) The high-carbon grades (types 420, 440A, 440B and 440C) should never be acid pickled in the fully hardened condition. Stress relieving at 300 to 700° F (150 to 370° C) for 1 to 2 hr after hardening and before pickling is essential to avoid pickling cracks. These grades require careful watching during the pickling operation to prevent severe etching. Polishing with iron-free abrasive grit or sandblasting are preferred methods of scale removal to avoid etching.

(*f*) *Molten Salt Treatment.*—Several molten salt treatments are suitable for scale removal.

(*1*) The molten sodium hydride bath-acid treatment[3] for scale removal is widely used commercially. In this process, the reduction of the scale is accomplished by immersion of the work in a molten sodium hydroxide bath containing 1½ to 2 per cent of sodium hydride. The scale is reduced in a period of time varying from a few seconds to about 15 min after the work has reached the operating temperature of 750° F (400° C). The work is then removed, quenched in water, given a brief dip in a sulfuric acid solution (10 per cent) and then brightened in a nitric acid solution (6 to 8 per cent) or 10 per cent nitric acid-2 per cent hydrofluoric acid solution.

(*a*) Although this process has been used primarily in large scale continuous units, intermittent use for smaller batch-type operations is practicable.

(*2*) Another molten-salt bath used successfully for scale treatment is the proprietary bath[4] containing sodium hydroxide and oxidizing salts.

(*3*) Both methods are especially suited for pickling stainless steel because the molten caustic does not attack the metal in any way.

(*g*) *Wire Brushing.*—Wire brushing to remove scale is suitable under certain conditions.

(*1*) Only stainless-steel-wire brushes should be used for wire brushing scale from stainless steel. Particles of steel from a carbon-steel brush will imbed themselves in the stainless steel and show rust in a very short time. Pickling after wire brushing is not very effective in removing imbedded particles. Stainless steel wire brushes are commercially available although not generally stocked.

(*2*) Commercial grinding compounds free from iron are probably more economical to use than stainless-steel-wire brushes.

[3]U. S. Patent No. 2,377,876.
[4]U. S. Patent Reissue 22,887 (Original U. S. Patent No. 2,395,694).

Buffalo Convention Financing

Since the July issue was printed, we have received the names of additional manufacturers of plating, processing and polishing equipment and supplies who generously aided in the financing of the Buffalo Convention. The Convention Committee and the Society express their sincere appreciation and thanks to the following:

American Buff Company, Chicago, Ill.

Bart-Messing Corporation, Belleville, N. J.

Belke Manufacturing Company, Chicago, Ill.

Crown Rheostat & Supply Company, Chicago, Ill.

Enequist Chemical Company, New York City

Enthone, Inc., New Haven, Conn.

Formax Manufacturing Company, Detroit, Mich.

Glover Coating Company, Malden, Mass.

Frederick Gumm Chemical Company, Kearny, N. J.

The Harshaw Chemical Company, Cleveland, Ohio

J. C. Miller Company, Grand Rapids, Mich.

Munning & Munning, Inc., Newark, N. J.

Nelson Chemicals Corporation, Detroit, Mich.

George A. Stutz Manufacturing Company, Chicago, Ill.

Wyandotte Chemicals Corporation, Wyandotte, Mich.

Washington Orders

Copies of NPA orders and publications may be obtained from National Production Authority, Washington 25, D.C. or from any of its local offices.

Availability.—The NPA, on June 20, issued a "List of Basic Materials and Alternatives, Issue No. 1" which indicates the current relative availability of 550 of the more important materials. Group I materials, in *very short supply*, includes, among others, lead, tin, zinc, platinum, rhodium, silver, nickel, boric acid, citric acid, copper sulfate, formaldehyde, hydrogen peroxide, sulfuric acid, trichlorethylene, cotton duck, hides and skins.

Group II materials, *in tight supply*, includes, among others, cadmium, palladium, aluminum chemicals, ammonia and ammonium chemicals, chromic acid, most copper chemicals, synthetic detergents, formic acid, hydrochloric acid, most lead chemicals, lime-sulfur solution, magnesium chemicals, mercury chemicals, nitric acid, phosphoric acids and other phosphorus chemicals, most potassium and sodium chemicals, tin chemicals, zinc chemicals, animal glues. Some plastics also fall in these two groups.

Carbon bisulfide.—According to NPA, June 12, there are no present plans to apply restrictions on use or allocation to this material.

Carbon brushes.—Critical shortage of copper powder is hampering production of carbon brushes, according to a report of June 27 by the Carbon Brush Manufacturers Industry Advisory Committee.

Carbon tetrachloride.—Total 1951 requirements being almost 260 million pounds and anticipated supplies only 220 million pounds, distribution of carbon tetrachloride will shortly become subject to complete control by NPA, according to an announcement made on June 12.

Controlled Materials Plan.—According to Direction 1 of Regulation 2, of June 25, certain DO-orders under programs of of the Department of Defense, the Atomic Energy Commission and the Coast Guard can be automatically converted to allotment numbers and will not be converted by the general procedure set forth in Section 5 of CMP Regulation 3.

Every person, regardless of class of producer or class of consumer, who receives a CMP allotment must maintain certain records. Suggested methods are given in "Allotment Accounting for Consumers under CMP", recently issued by NPA.

A revised second edition of the "Product Assignment Directory and Official CMP Class B Product List" for use in getting 4th quarter CMP allotments was published on July 1.

"Questions and Answers on the Controlled Materials Plan" was issued on June 7. One of the general questions is, "What arrangements have been made for electroplating shops to operate under CMP"? The answer given is, "These shops have the status of service shops and should apply on Form CMP—4B if the amounts of controlled materials required are greater than can be obtained from a warehouse. Manufacturers operating plating departments within their own plants, and plating their own products, include their plating requirements for controlled materials on their CMP—4A or CMP—4B applications the same as for other production material. Where obtainable from warehouse stocks, small orders may be filled by use of the allotment symbol provided in Direction 1 to CMP Regulation 1.

See also under "Copper".

Copper.—According to Direction 1 to CMP Regulation 1, dated June 8, a producer of Class B products not marked by an asterisk in the Official CMP Class B Product List need not apply to NPA for copper if his quarterly requirement is 500 lb or less. Instead he is authorized to use the allotment symbol SU (small user) on delivery orders for the copper. The same producer is also authorized to use a DO-SU rating on delivery orders for production materials as defined in CMP Reg. 3. As usual, the allotment may be extended to job platers.

The use of copper in certain consumer durable goods (furniture and fixtures, utensils and cutlery, radio, television and phonographs, transportation equipment, miscellaneous items, accessories on a List A; and a variety of items on a List B) is now completely controlled by NPA order M-47A, issued on July 1, 1951. The manufacturer, except users of certain small amounts, is limited to an average quarterly use of 60 per cent of base-period quarterly use of all List A items taken together and 80 per cent of all List B items taken together. Maximum monthly use is 40 per cent of permitted quarterly use. There is no limitation on whether the copper or copper-alloy plate is an undercoating or a final coating. Any person who receives an allotment for a CMP Class B product subject to this new order is not thereafter subject to the order.

Order M-12 was changed drastically on July 12. It now controls only such uses of copper as are not limited or controlled by CMP allotments, DO-orders, or other applicable NPA orders, such as the aforesaid Order M-47A. For these remaining applications, during July, 1951 and each month thereafter, no person shall use in any process (such as plating) a quantity by weight of copper (as defined) in excess of 75 per cent of his average monthly use during the base period (January-June, 1950). Exception is made for small users, of 1000 lb copper per calendar quarter or less. There is no limitation on whether the copper or copper-alloy plate is an undercoating or a final coating.

See also "Controlled Materials Plan".

Laboratories.—Order M-71, "Priorities Assistance to Technical and Scientific Laboratories" was issued on June 26. The definition of "laboratory" includes, without limitation, the following: research, production-control, testing, analytical and instructional laboratories; but excludes laboratories to the extent that they are engaged in the manufacture of products for commercial sale or public distribution.

To get a small quantity of controlled material (up to a specified amount) the laboratory places on its delivery order an allotment symbol X1 and a certification, "Certified under NPA Order M-71", signed as provided in Section 8 of NPA Reg. 2. To get other than controlled materials, including chemicals, the laboratory uses a DO-X1 rating and the aforesaid certificate.

The same order also sets forth methods for obtaining both larger quantities of controlled materials and Class A products is defined in CMP Reg. No. 1.

Lead.—Sharp reduction in lead imports, because of the U. S. price ceilings and heavier defense and defense-supporting requirements, will soon cause NPA to allocate monthly soft pig lead from primary producers to consumers on the basis of consumption during a selected base period. This announcement was made on June 13 by NPA officials.

Nickel.—Anodes and chemicals are now being allocated monthly, and suppliers should be furnished, by the 20th day of the month preceding the filing date (approximately 40 days before the delivery), the necessary information, including Government contract numbers and DO-ratings, if any, end uses, and required delivery date.

The nickel shortage continues acute and may grow worse, according to an NPA statement on June 21. Reduced import of nickel ores, heavy demand for nickel in jet aircraft motors, newly developed ordnance equipment, and important civilian needs were cited as reasons.

Zinc.—The demand for zinc is still substantially in excess of supply. Beginning August 1, this metal will be placed under allocation, NPA officials said on June 21.

The zinc-use Order, M-15, was amended on June 15 to eliminate zinc alloys from the definition of "zinc". "Zinc" now means only slab zinc which has been produced by electrolytic, electrothermic or fire-refining process, including zinc produced from scrap, dross, or other secondary materials.

project no. 12

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location:
COLUMBIA UNIVERSITY, NEW YORK CITY

Acknowledgment is due the Research Committee, Dr. W. A. Wesley, The International Nickel Company, Chairman; the Research Directing Committee, Mr. G. M. Cole, Ternstedt Division, General Motors Corporation, and Dr. Donald Price, Oakite Products, Inc., Chairman and Vice-Chairman, respectively; and the Project Committee, Mr. E. T. Candee, Lea Manufacturing Company, Chairman; Dr. W. A. LaLande, Jr., Pennsylvania Salt Manufacturing Company, and Dr. Edward Parker, Technic, Inc., for their contributions to this project.

*AUTHORS

Cleaning and Preparation of Metals for Electroplating

III. DEGREASING EVALUATION TESTS: THE ATOMIZER TEST

Continued from July 1951 Issue

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4. THEORY

We have presented in this paper a new degreasing-evaluation test, have indicated its nature, given details on equipment and procedure, and presented some typical results obtained with this test. In this last section of the paper will be found a discussion of the theory which underlies all wettability tests and a detailed analysis of the reasons for the greater sensitivity of the atomizer test than of the water-break and spray-pattern tests. The general theory of wettability of metals will be discussed only in so far as it concerns the tests being employed in this project. More extended treatments may be found elsewhere, as for example in the works of Adam[207], Bikerman[212], Burdon[218], and Rideal[229].

(a) *Surface Forces and the Contact Angle*

Liquid-liquid interface.—Any system tends to assume a condition of minimum free energy. In the case of surfaces, the free surface energy is numerically equal to the surface tension. Cohesion may be described as the work necessary to separate any internal cross-section of a body. Since such a break exposes two new surfaces the area of which is equal to the given cross-section,

$$W_c = 2\sigma \qquad (1)$$

where W is the work and σ the surface tension. A similiar definition of adhesion would lead to:

$$W_a = \sigma_A + \sigma_B - \sigma_{AB} \qquad (2)$$

as two new surfaces, of surface tensions σ_A and σ_B are created, and one interfacial surface, of tension σ_{AB}, is destroyed. The equation was first expressed by Dupre[230]. These relations may be used directly when a drop of one liquid, A, placed on the surface of another, B, is being considered, and the two liquids are assumed to be substantially insoluble. Thus, if the work of adhesion is greater than the work of cohesion of the liquid in the drop, the drop will spread to keep the total free energy of the system at a minimum. Mathematically expressed:

$$\sigma_A + \sigma_B - \sigma_{AB} > 2\sigma_A \qquad (3)$$

or

$$\sigma_B - \sigma_A - \sigma_{AB} > 0 \qquad (4)$$

The term on the left of equation (4) is often called the *spreading coefficient* (e. g., Harkins[235]). Thus, if the spreading coefficient is positive, the liquid drop will spread. On the other hand, if the work of cohesion of the drop is greater than the work of adhesion, the drop will not spread. In this case, the spreading coefficient is negative.

Liquid-solid interface.—When the spreading of a liquid drop on a solid surface is being considered, however, these relation-

TABLE V. CONTACT ANGLE VALUES

Temperature: 18–20° C, except where otherwise indicated

Substance	Surface Tension dynes/cm	Interfacial Tension dynes/cm	Contact Angle		
			α'	α''	α_m
Benzene	28.9	35.0	.....	.....	95°
Octane	21.8	50.8	.....	.....	114°
Oleic acid	32.5	15.6	80°	55°	.....
Stearic acid	.....	.....	105°	55°	.....
Tristearin	29.6[40]	.....	120°	.....	.....
Paraffin wax	.....	.....	111°	96°	.....
Paraffin oil	23.4	63.1	.....	.....	123°

ships cannot be used directly, for neither the surface tension of a solid nor the interfacial tension between a solid and a liquid may be satisfactorily measured directly. This problem is solved by using the concept of the contact angle. When a drop is placed on a metal surface, there are operative three surface forces, σ_S, σ_L and σ_{SL} which must come into equilibrium. From the laws of mechanics, it can be easily seen that, at equilibrium,

$$\sigma_L \cos \alpha + \sigma_{SL} = \sigma_S \qquad (5)$$

where α is called the *contact angle*. Fig. 3a–c illustrates this; σ_S and σ_{SL} operate parallel to the metal surface and in opposite directions, and σ_L operates in the direction of the arrows in the diagrams. Combining equations (2) and (5), we obtain Young's equation[232] for the work of adhesion, which involves only two measurable quantities, α and σ_L:

$$W_{SL} = \sigma_L (1 + \cos \alpha) \qquad (6)$$

If $\alpha = 0°$, then $W_{SL} = 2\sigma_L$, which was previously defined as the work of cohesion of the liquid. This leads to a definition of wettability for solids:

A solid surface is wettable when the adhesive force between it and the surface of a liquid equals or exceeds the cohesive force of the surface of the liquid, i.e., when the contact angle is zero.

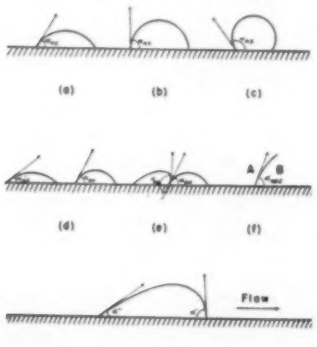

Fig. 3. Contact-angle phenomena

If the contact angle has any value other than zero, then the surface is not completely wettable. This is the concept of wettability which will be used by the present authors. Some authors, however, prefer to consider surfaces as being wettable if the contact angle is acute (Fig. 3a) and nonwettable if obtuse (Fig. 3c), the dividing line between wettability and nonwettability being shown by a drop such as that in Fig. 3b.

Completely clean metal surfaces have zero contact angle with water, i.e., they are completely wettable. This fact has been proven by Thomson's studies[246] on cleavage planes of single crystals, probably the source of the cleanest and most perfect solid surfaces. However, if such a clean solid surface is left unprotected in air for a short time, it becomes coated with a film of greasy material in about one hour or less. Thus, though freshly split mica surfaces seize, Quinke[226] reports that they slide after a short exposure to air. Macaulay[231], working with city air in Glasgow, Scotland, has shown that this greasy layer is probably deposited mainly by simple settling from air, as seizing power is lost more rapidly if such surfaces are placed uppermost than if placed vertically with protection against air currents. When the clean face is placed downwards, power of seizure may be retained for more than two days. Condensation phenomena have also substantiated these observations; they will be discussed in a later paper. These observations are also verified by studies of "oriented overgrowths". If exposure to air is sufficiently long, the grease film may grow to such an extent that, on testing a metal surface for electron-diffraction patterns, Trillat[247] found only the grease pattern.

Liquid-liquid-solid interface.—Equations can be developed as before for the case of two liquids, *A* and *B*, simultaneously contacting a solid. From the previous equations we have that

$$W_{AS} = \sigma_A + \sigma_S - \sigma_{AS} = \sigma_A (1 + \cos \alpha_{AS}) \qquad (7)$$

and

$$W_{BS} = \sigma_B + \sigma_S - \sigma_{BS} = \sigma_B (1 + \cos \alpha_{BS}) \qquad (8)$$

This situation is illustrated in Fig. 3d. Suppose that the drop of liquid *A* is moving slowly along the surface and finally comes into contact with liquid *B*. Initially, there will be formed a new contact angle, α_{AB}, (Fig. 3e:) determined by:

$$W_{AB} = \sigma_A (1 + \cos \alpha_{AB}) \qquad (9)$$

If drop *A* continues to move, air will be excluded from the interface solid-liquid *B*-liquid *A*, and a new equilibrium is set up (Fig. 3f):

$$\sigma_{AS} = \sigma_{AB} \cos \alpha_{ABS} + \sigma_{BS} \qquad (10)$$

Note that if *A* is air instead of another liquid, this reduces to equation (5). Substituting in equations (7), (8) and (10),

$$W_{BS} - W_{AS} = \sigma_B - \sigma_A + \sigma_{AB} \cos \alpha_{ABS} \qquad (11)$$

It was shown previously that W_{SL} can be obtained from the contact angle, but that the contact angle is zero if adhesive forces are equal to or greater than cohesive forces. Under such circumstances, Bartell and Osterhaf[211] reported that W_{SL} can be determined by adding a second liquid which gives a finite angle with the solid and against the first liquid

(b) *Hysteresis of the Contact Angle*

Up to this point, the contact angle has been treated as a constant for any particular set of surface conditions. However, this is not strictly the case. Consider, for example, a drop traveling down an inclined surface (Fig. 3g). The advancing contact angle, α', is greater than the receding contact angle, α''. This phenomenon was first noted around the start of the century by Pockels[235] and Rayleigh[237] and was thought to be due to surface contamination. Sulman[242] called this effect the hysteresis of the contact angle and suggested that it might be associated with a frictional resistance to movement of a liquid over a solid surface: the advancing angle is that between a liquid and a dry solid surface, the receding angle that between a liquid and a previously wetted surface. Adam[207] stated that hysteresis of the contact angle is reduced by previous heating of the surface and by cleaning it, and thus concludes that the high value of the advancing angle is due to the presence of a thin film which is wholly or partially removed by the passage of the drop. This film may be of greasy nature, or may even consist of nothing more than adsorbed air. Langmuir[228] suggested that in some cases the difference in contact-angle values may be due to the action of the drop in causing molecules to turn over, i.e., in causing a molecule with a hydrophobic end and a hydrophilic end to turn over so as to have

the hydrophilic end projecting from the surface after passage of the drop.

More recently, Macdougall and Ockrent[223] have developed a new theory for this phenomenon. They observed that any liquid exhibits two characteristic, constant, and reproducible contact angles, called the constant advancing angle and the minimum receding angle, obtained by placing a drop on a surface and gradually tilting the surface until the drop slides. The angles were found to be independent of the solid surface, initial contact angle, and size of drop. They propose that hysteresis of the contact angle is due to the fact that the adhesion of liquid to solid involves an adsorbed oriented monomolecular layer of liquid molecules on the surface, so that work is done in forming the layer, and is regained on removal.

The effect of roughness on contact angle is not well established. Adam and Jessop[224] reported that hysteresis seems to increase with increasing roughness. There is evidence (see Adam[207], Lee[230], and Thiessen and Schoon[245]) that if the advancing angle is greater than 90°, roughness increases the value of the angle, and if less than 90°, decreases the value. Wenzel has suggested the following equation[251]:

$$\cos a = r(\sigma_S - \sigma_{SL})/\sigma_L \qquad (12)$$

where r is the ratio of the real surface area to the apparent surface area.

Hysteresis has a practical application in pre-plating and plating operations, in that the wetting of a dry surface and the spreading of solutions on a dry surface are related to the advancing contact angle, and drag-out is a function of the receding angle, as was shown by Evans and Martin[222].

Table V contains information on the contact angle between water droplets and surfaces contaminated with the indicated compounds. Compounds typical of ingredients of commercial oils, fats, and waxes, and typical solvents are presented. The figures in the table were taken or derived from a variety of sources[96,206,207,211,212,214,215,220,222,233,240,251]. Wakeham and Skau[244] stated that for water-repellant fabrics, the contact angle is 62°–106°. Wark and Cox[250] stated that small quantities of surface-active agents greatly reduce the contact angle.

(c) *Water-Break*

The test sample is submerged in water. It is then removed and drained in air. As drainage proceeds, the water film becomes thinner, and when it is sufficiently thin for the surface forces to act, the local value of the receding contact angle will determine whether the water film contracts suddenly to leave the surface dry, or whether evaporation and drainage continue to decrease the film thickness in a regular fashion until the film disappears (producing interference fringes on polished surfaces). In some cases of poor wettability, retraction of the film may not always be spontaneous because of "bridging". Applying the tip of a hot wire will then serve to initiate retraction by creating a local dry spot. The role of "bridging" in obscuring the results of the water-break test appears to be connected with the nature of the retraction of the water film, which was first discussed by Devaux[213]. The retraction is generally irregular, and tends to consist of discreet steps. When the differential forces which are causing the retraction are sufficiently small, the film will persist, even though the surface is not completely wettable. Because the panel is draining, it is evident that the test is more sensitive near the top of the panel under test than elsewhere on the surface.

(d) *Spray-Pattern*

After a suitable interval, the panel receiving the water-break test is sprayed. Where the panel is wetted, the contact angle is obviously zero. Where the panel is dry, drops will form, the shape of which is determined by the advancing contact angle. Because the receding contact angle at such points is sufficiently great to cause water-break, i. e., retraction of the film to leave a dry area, and because this angle is less than the advancing contact angle, it is evident that the drops thus formed will not spread appreciably. Hence, a method of recording quantitatively the results of the water-break test is provided. The other remarks made about the water-break test apply here as well.

(e) *Atomizer*

This new test is operated in the same manner as the spray-pattern test, except that the panel being tested is dry. As a result, the entire pattern is determined by the value of the advancing contact angle. This being so, the results of such a test must differ significantly from those of the two tests above, the water-break test being entirely dependent on receding angles, and the appearance of the panels in the spray-pattern test being dependent partly on both types. Thus, Evans and Martin[222] have found that, for most solutions, the amount of liquid retained on the surface when the excess drains away is a function of the receding angle, whereas the area of spreading, as determined by the area covered by a drop of standard size delivered from a capillary tube onto the surface, depends on the advancing angle. The other important difference between the atomizer test and the previous two is that in the atomizer test there is virtually no problem of "bridging", since a thick film of water cannot develop except on completely wettable surfaces ($a = 0°$).

Five different occurrences may take place on atomizer testing:

(i) A contaminant is present which causes the contact angle to be greater than 90°, and covers an appreciable area. The drops will have a shape like that in Fig. 3c; they will be quite small in size, and there will be a large number of them per unit area. Such an area is considered "soiled" in the atomizer test. Such areas cause water-break and result in the same appearance of the panel in the spray-pattern test as in the atomizer test.

(ii) A contaminant is present which causes the contact angle to have a value less than 90°, and covers an appreciable area. The drops will resemble that of Fig. 3a; they will be comparatively large in area, irregular in contour, and there will be a relatively small number of drops per unit area. Such an area is considered "soiled" in the atomizer test. Unlike those in (i) above, such areas are often not likely to be revealed in the water-break and spray-pattern tests. Because the advancing contact angle is small, the receding contact angle may often be so close to zero as to cause a film of water to be retained (unless special steps are taken, such as the use of a hot wire).

(iii) A contaminant is present which causes the contact angle to exceed about 30°, and it is present randomly throughout the panel surface as extremely small globules or film patches, surrounded by very much larger, completely or largely wettable areas (a is zero or nearly so). Then a situation analogous to that of Fig. 3d-e arises. A thin film or a very flat lens of water will spread on the clean surface until it reaches the point of contamination. At this point, the contact angle increases suddenly (Fig. 3e), and the spreading of the drop ceases. The drops will be quite large in area, irregular in contour (the hindmost portion of the perimeter may be virtually without any sharp line of demarcation), and there may be only a scattered number of drops over a wide area. Such an area is considered "soiled" in the atomizer test. This is the condition of greatest departure in results of the atomizer test from those of the water-break and spray-pattern tests. In the two latter tests, "bridging" generally obscures such contamination completely. It will also be noted that the atomizer test is not a true measure of the area covered by this contamination, because the presence of small areas of contaminant results in large "soiled" areas in the atomizer-test results. If the contact angle on the contaminated area is very small, then the spreading film of water will rise up the surface of the contaminant until it covers it as in Fig. 3f. This is the equivalent of "bridging" in the water-break test, and the atomizer test will not detect such a contaminant.

(iv) A contaminant is present which causes the contact angle to exceed 90°, and it is present as a completely isolated, more or less horizontal ridge on an other-

TABLE VI. ATOMIZER TEST RESULTS

Cleaning Condition		Mineral Oil					Lard Oil				
Temp °C	Time min	Deg. of Freed. t	$t_{0.05}$	L	χ_1^2 / χ_2^2		Deg. of Freed. t	$t_{0.05}$	L	χ_1^2 / χ_2^2	
Effect of Time (Temp Constant)											
100	3–10	...	...	...	...	...	25	27.2	2.06	5.7	74.2
70	3–10	16	1.67	2.12	8.8	6.9	22	3.08	2.07	5.8	8.7
	10–20	19	1.98	2.09	7.6	7.2	19	3.98	2.09	8.1	15.5
	3–20	19	0.36	2.09	1.7	0.3	19	5.64	2.09	9.0	24.2
40	3–10	16	0.53	2.12	14.8	3.7	...	...	...	...	...
	10–20	13	0.44	2.16	14.7	3.0	...	...	...	...	...
	3–20	19	0.12	2.09	12.2	0.7	...	...	...	...	...
Effect of Temperature (Time Constant)											
100–70	3	19	1.32	2.09	3.0	1.9	22	3.60	2.07	7.4	12.8
70–40		19	13.0	2.09	9.9	61.5	...	...	...	...	...
100–40		22	14.2	2.07	8.7	59.6	...	...	...	...	...
100–70	10	...	...	...	...	...	25	38.7	2.06	4.2	78.3
70–40		13	7.5	2.15	14.6	50.9	...	...	...	...	...
70–40	20	19	17.3	2.09	7.4	61.1	10	5.20	2.23	14.2	33.2

wise completely or largely wettable surface. Then, the water on the panel will be in the form of a thin film or very flat lens, "dammed-up" at one point on the surface in a heavy roll. As spraying continues, water will eventually spill over the dam at its weakest point, relieving the pressure and thinning the "dammed-up" film. No drop-like formation develops, and such an area is considered "clean" in the atomizer test. Such a contaminant is not likely to reveal its presence in either the water-break or spray-pattern test.

(v) The surface is completely wettable, or it contains a contaminant which causes the contact angle to be so nearly zero that a very flat lens of water develops which, during the course of spraying, readily converts to a thin film indistinguishable from the film resulting from a completely wettable surface with zero contact angle. Such a contaminant is not revealed by the atomizer test, nor by the water-break or spray-pattern test.

In conducting the atomizer test, spraying is continued long enough to develop the pattern (see Procedure, p. 714), but must be stopped before the first drop grows large enough to roll down the surface spontaneously. When a drop rolls down the surface, the pattern in its wake becomes dependent on the receding contact angle, which may change the results obtained, unless the receding angle is sufficiently large to cause water-break.

(f) *Other Wettability Tests*

Condensation.—When a cool surface is exposed to a vapor, such as steam, condensation takes place either as a film or as discreet drops, depending upon the wetting characteristics of the surface. Such studies have been very important in the field of heat transfer. As a separate paper will be presented in the future contrasting condensation and atomizer tests, nothing further will be said here about such tests.

Flotation.—Flotation phenomena have been of great importance to mining engineers in the field of ore beneficiation. Inasmuch as wetting studies of this type, however, deal with solid particles rather than with continuous surfaces, they are of little direct interest to platers, and will not be taken up here.

Droplet shape.—Wetting characteristics may be investigated by studying single drops: noting advancing and receding contact angles, angle of tilt required to cause spontaneous rolling, contour of the drop, etc. Satisfactory methods for such measurements appear in the literature[200,207,208,209,210,214,216,217,222,224,226,227,229,234,235,238,240,241,242,247,250]. Such a study has two limitations when the plater's problems are considered. First, in metal cleaning, contaminants are rarely present on the surface in a homogeneous fashion. Thus, drop characteristics will vary from point to point. Second, knowledge of hysteresis, role of the surface, etc., is just about reaching the point where significant data can be obtained, so that most previous drop studies must be viewed with skepticism. However, in future years, drop studies will probably come into increasing importance in the study of cleaning prior to plating.

(g) *Sensitivity of Wettability Tests*

A few words must be said concerning the reason for selecting wettability tests for study in this project. There are three main reasons for the choice. Wettability tests, such as the water-break, spray-pattern, atomizer, and condensation tests are:

(1) Simple to conduct
(2) Inexpensive to set up
(3) Highly sensitive

With regard to the first point, no special training or technical skill is required to conduct routine tests of such a nature. As to the second point, no equipment is required other than a small air-operated sprayer. Concerning sensitivity, it has been frequently shown that one molecular layer of a water-repellant material can be detected[44,207,212,213,219,227,228a,232]. However, in the case of polar compounds, orientation of the molecules is important, because one portion of the molecule may be hydrophilic, another hydrophobic. Furthermore, Langmuir[221] has stated that contact with water may cause overturning of molecules, so that the surface may change from hydrophobic to hydrophilic. Devaux[219] has shown that an oriented layer of molecules of fatty acids and oils, even less than one complete layer thick, can cause water-break. With Japan wax (tripalmitin), he found water-break when the concentration was 2×10^{-8} g/cm^2 (concentration of a monolayer is 11×10^{-8} g/cm^2). With olive oil, the minimal concentration was 5.1×10^{-8} g/cm^2 (concentration of a monolayer is 10×10^{-8} g/cm^2). Thus, it is seen that wettability is probably unrivalled in sensitivity by any other readily detectable chemical or physical property.

Recent papers by Harris[72a,72b] seem to indicate much poorer sensitivity for the water-break test. There may be a number of reasons for this, such as: (a) rinsing after cleaning was incomplete, leaving a thin hydrophilic film on the surface (a monolayer would suffice to obscure results), (b) the immersion in water oriented the residual contaminant so as to present a hydrophilic surface (akin to Langmuir's overturned layers[221]), or (c) the rinsing prior to testing removed the film (see Donelson[44] on a method for detecting oil by immersion into water in an inverse of the Langmuir technique for the application of monolayers).

(h) *Range of Application of Wettability Tests*

It must be clearly emphasized that although wettability tests are extremely sensitive in detecting contaminants, not all

contaminants present on a surface prior to plating are nonwettable.

Examples of commonly encountered nonwettable contaminants are: oils, fats, and waxes; fatty acids and their salts; adsorbed gases; some organic solvents; dust from the air; graphite; some carbon and carbide residues.

Examples of commonly encountered wettable contaminants are: metal oxides and most other products of metallic corrosion; most passive surfaces; scale, cleaning residues in the form of compounds with the metal, such as silicates and phosphates; water-soluble acids, bases, and salts, such as alkaline-cleaner residues. (Excessive roughness of the surface will so lower the value of the contact angle (see Wentzel's equation, above) as to render almost any surface wettable, but this situation can hardly concern the plater.) Naturally, contaminants of this type are not detectable by wettability tests, or generally by the other degreasing-evaluation tests listed previously[109e].

5. Appendices

(a) *Statistical analysis of atomizer test results*

The results obtained with the atomizer test were discussed qualitatively in section 3c, Discussion. Here, these results will be discussed quantitatively in terms of the statistical criteria used in this project[109d]. The results shown in Table III and Fig. 2 are rearranged in Table VI in terms of t and L data.

Effect of time at constant temperature.—For lard oil, at 100° C, the difference in index value between 3 and 10 minutes is well established, as can be seen from the very large value of t. At 70° C, the same holds true for the time intervals 3–10, 10–20 and 3–20 minutes, except that here, since C. I. does not rise very rapidly with time, these differences are less well established. Nonetheless, t is 1½–2½ times larger than $t_{0.95}$, i. e., L ranges from 37 to 67 per cent of the value of $\bar{X}_1 - \bar{X}_2$. With mineral oil, the reverse is true. The value of t is very small, and L is in all cases larger than $\bar{X}_1 - \bar{X}_2$, especially at 40° C, where L is at least four or more times larger. Thus, although there are minor changes in C.I. with time in the case of mineral oil, these changes are statistically meaningless.

Effect of temperature at constant time.—For lard oil the effect of raising the temperature from 70° to 100° at 10 minutes, and from 40° to 70° at 20 minutes is well established, as is seen from the large value of t. L is 5 to 43 per cent of the value of $\bar{X}_1 - \bar{X}_2$. At 3 minutes, the effect of raising the temperature from 70° to 100° is not as well established, as C.I. is rather low at 3 minutes for both temperatures. Nonetheless, t is somewhat larger than $t_{0.95}$, and therefore the difference is statistically meaningful. In the case of mineral oil, the effect of raising the temperature from 40° to 70° and from 40° to 100° at 3, 10, and 20 minutes is statistically well established, as t is large, and L is 12 to 29 per cent of the value of $\bar{X}_1 - \bar{X}_2$. On the other hand, the effect of raising the temperature from 70° to 100° is not statistically established, as t is small, and L is 1.7 times as large as $\bar{X}_1 - \bar{X}_2$. In other words, it is not statistically proven that raising the temperature from 70° to 100° changed the cleaning value.

TABLE VII. EFFECT OF IRREGULARITIES IN PROCEDURE

Cleaning Condition		Mineral Oil				Lard Oil			
Temp °C	Time min	Solvents	C.I.	σ	n	Solvents	C.I.	σ	n
Effect of Impure Solvents									
100	3	Std.	96.8	3.9	12	Std.	21.8	9.4	12
		Used	55.5	7.0	3	Used	43.2	15.7	3
70	10	Std.	91.8	12.2	9	....	....	....	..
		Used	41.7	5.8	3	....	....	....	..
70	20	....	....	....	..	Std.	33.2	11.7	9
		....	....	....	..	Used	64.1	8.3	3
40	10	Std.	40.9	13.9	6	....	....	..	..
		Used	20.5	2.3	3	....	....	..	..
Effect of Acid Dip									
100	3	....	....	....	..	Std.	21.8	9.4	12
		....	....	....	..	No acid	85.2	7.2	3

(b) *Reproducibility of the atomizer test*

Fig. 4 contains a plot of σ versus C.I. The values of σ for all the runs made at the same cleaning conditions were given in Table III. The values of σ for the three samples tested together in any given run appear in Appendix (e). It will be seen in the graph that σ is quite high, and that a line corresponding to $\sigma = 0.30$ C.I. (where C.I. = 0–50) and $\sigma = 0.30$ (100 − C.I.) (where C.I. = 50–100), approximates the value of σ to be expected. In the range of C.I. = 0–5 and 95–100, this linear relationship does not hold, because it would imply that σ would diminish as C.I. approaches 0 or 100, finally reaching 0. Actually, the value of σ probably tapers off to a value of about 1 in the regions of C.I. = 0 and 100.

Comparison of σ values for individual runs with those for the average of all runs at any given cleaning condition shows the latter values to be the larger to a small degree. The conclusion to be drawn from this is that a certain element of irreproducibility is involved in comparing the performance of one cleaning bath with that of another prepared in a supposedly identical manner. This irreproducibility between cleaning bath performances, however, is quite small.

The value of σ is quite high in comparison with the reproducibility of other tests reported in the literature. The reason for this is the very sensitivity of this test. In the regions around C.I. = 0 and 100, the value of σ is acceptably small. As C.I. approaches 50, σ begins to become large. Since a very small amount of tiny droplets can cause formation of agglomerated water globules over a relatively large area, it is evident that just a very small change in the amount of residual oil present will cause a relatively large change in the cleaning-index value. Thus, the reason for the increasing value of σ

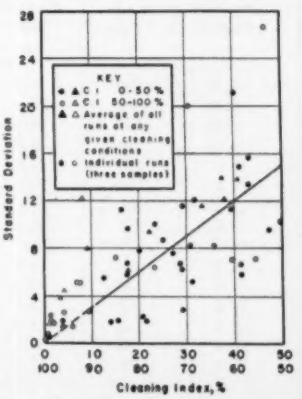

Fig 4. Reproducibility of the atomizer test

TABLE VIII. POINT AT WHICH TO REJECT SOLVENTS

Temp, °C	100	100	70	70	70	40	40	40
Time, min	3	10	3	10	20	3	10	20
Mineral Oil								
>	10	...	8	8	13	14	8	12
<	17	...	12	10	..	..	15	..
Lard Oil								
>	13	15	11	14	9	..	..	13
<	16	...	..	..	11	..	..	..

as C.I. approaches 50 becomes evident. Another way of putting it is to say that the atomizer test tends to approach a stop-and-go type of test. As residual oil on a panel decreases, the C.I. remains quite small, until a critical level is reached, after which any further small decrease in residual oil present causes the C.I. to rise to very high values.

(c) *Effect of Irregularities in Procedure*

As the solvents become used, they pick up contaminants of various sorts due to drag-out, which may cause oxidation on the panel surface during soiling, deposition of salts, etc. It was shown in the paper on "Cleaning and Soiling Procedures"[102d] that the solvents could be used quite a number of times before differences in soiling characteristics manifested themselves because of such contamination. However, as might be expected, the cleaning characteristics are more critical with respect to age of solvents. The effect of used solvents upon cleaning-index values is rather marked, as can be seen in Table VII. In the case of mineral oil, the cleaning index for used solvents is 51 per cent of the value for standard solvents (σ = 6.1 per cent, n = 3). For lard oil, contrariwise, the cleaning index for used solvents is 196 per cent of the value for standard solvents (σ = 4.0 per cent, n = 2). Since the surface effects produced by utilizing used solvents are complex, it is not easy to ascribe any definite reason for the cleaning-index changes observed.

With respect to the number of times that the solvents may be used before rather abrupt changes take place in the results, Table VIII shows the results obtained for the various cleaning conditions investigated. Although the changes in cleaning-index value were rather abrupt as the solvents became overage, the results obtained for the various cleaning conditions were not entirely consistent. This is probably due to differences in drag-out from one run to the next, atmospheric conditions in the laboratory, etc. In general, however, the pickle and solvent baths should not be used more than ten times.

After the alkaline cleaning and rinsing steps, the procedure calls for a pre-testing step, consisting of a 1 per cent HCl dip (1 min) and a water rinse (2 min). Table VII illustrates one effect of eliminating this step. The higher cleaning-index value obtained is apparently due to the fact that alkaline films or metal soaps or both remain on the surface of the panel after cleaning and rinsing. Such films cause false absence of water-break and are evidently removed by a brief acid dip.

(d) *Spraying Characteristics*

1. *Drop-size distribution data.*—The instrument which has been used is a de Vilbiss No. 251 bulb atomizer. The manufacturer kindly brought to the attention of the authors a recent article by Abramson[103], which contains a drop-size distribution chart for this atomizer. The data were obtained originally by Dr. H. G. Houghton of M.I.T. using a calcium chloride solution, the concentration of which was adjusted so as to eliminate the problem of evaporation of water droplets. Table IX presents these data. The solution used by Houghton compares as follows with that of the authors:

Substance	*Houghton* 20% $CaCl_2$ Solution	*Linford and Saubestre* Water
Surface tension, dynes/cm	81	73
Viscosity, poises	0.02	0.01
Density, g/cm³	1.18	1.00
Air pressure, cm Hg	51.8	45.7

In order to use the data, therefore, a correlation between the two systems must be made. The best method for correlating spray characteristics appears to be that due to Nukiyama and Tanasawa[200].

2. *The Nukiyama and Tanasawa equation.*—Two basic equations are used in this correlation. The first can be evaluated from laboratory drop-size distribution data, such as those of Table IX. The second can then be used to correlate the performance of any given instrument when used in the following ranges:

Density of liquid is 0.7–1.2 g/cm³
Viscosity of liquid is 0.003–0.5 poises
Surface tension of liquid is 19–73 dynes/cm
Pressure of air is 1 atmosphere or less

The two equations follow:

$$\frac{dn}{dx} = ax^2 e^{-bx^q} \qquad (1)$$

$$D_0 = \frac{585\sqrt{\sigma}}{v\sqrt{\rho}} + 597\left(\frac{\eta}{\sqrt{\rho\sigma}}\right)^{0.45}$$

TABLE IX. DROP SIZE DISTRIBUTION DATA FOR THE DE VILBISS NO. 251 ATOMIZER[103]

Volume of solution: 1/38,400 ml. No. of drops/ml: 234,000,000

Nominal Radius μ	No. of Drops	Nominal Radius μ	No. of Drops	Nominal Radius μ	No. of Drops
0.65	1930	19.3	26	38.7	2
1.30	1060	20.6	26	40.0	2
2.60	750	21.9	20	41.3	2
3.9	750	23.2	15	42.6	2
5.2	380	24.5	17	43.9	2
6.4	275	25.8	9	45.2	2
7.7	164	27.1	7	46.5	2
9.0	171	28.4	4	47.7	1
10.3	129	29.7	7	49.0	1
11.6	95	31.0	1	50.3	1
12.9	78	32.2	5	51.6	0
14.2	62	33.5	5	52.9	1
15.5	55	34.8	5	54.2	1
16.8	33	36.1	7	58.0	1
18.1	22	37.4	4		
				Total	6092

$$\left(1000\,\frac{Q_l}{Q_a}\right)^{1.5} \qquad (2)$$

Nomenclature:

- a, b, q = constants, determined as indicated below
- D_v = diameter of a single droplet with the same ratio of surface to volume as the total sum of drops in microns
$$= \int_0^\infty x^3 dn \Big/ \int_0^\infty x^2 dn$$
= "characteristic diameter"
- n = number of drops
- Q_l/Q_a = ratio of volumetric flow rate of liquid to that of air at the *vena contracta*
- v = relative velocity between the air stream and the liquid stream in m/sec
- x = diameter of an individual drop in microns
- η = viscosity of liquid in poises
- ρ = density of liquid in g/cm³
- σ = surface tension of liquid in dynes/cm

3. *Plotting drop-size distribution data.*—The procedure given below is a modification of one originated by Lewis, et al.[119].

An inspection of equation (1) above indicates that a plot of $\ln\left(\frac{1}{x^2}\frac{dn}{dx}\right)$ *vs* x will yield a straight line, the slope of which is $-b$, and the intercept of which is $\ln a$. The value of q is determined by trial and error by making the indicated plot for values of q of 2, 1, ½, 1/3, ¼, 1/5, etc., and observing which value of q results in a straight line. A plot of Houghton's data yielded a straight line for $q = 1/3$ (Fig. 5). The value of q is characteristic of the sprayer and is constant over wide ranges of operating conditions. From the slope of the curve, b is found to be 4.34. From Lewis' table[119], when $q = 1/3$, $D_v = 4080/b^3$, or 49.9 microns.

4. *Correlation Equation.*—Equation (2) may now be used to correlate the size distribution for Houghton's system and that of the authors. In this equation, v and Q_l/Q_a remain to be evaluated. To determine v, the equation for flow through a venturi tube may be used:

$$v = \left(2g_c\left[\frac{k}{k-1}\right]\frac{RT_1}{M}\left[1-\left(\frac{p_2}{p_1}\right)^{(k-1)/k}\right]\right)^{1/2}$$

Nomenclature:

- g_c = 981 cm/sec²
- k = ratio of specific heats = 1.40
- M = molecular weight of air = 29.0
- p = pressure (any units)
- R = gas constant = 8.48 x 10⁴ g-cm/° K-mol
- T_1 = absolute temperature = 293° K
- 1 = upstream
- 2 = downstream

Assumptions:

1. Liquid velocity is zero
2. Evaporation is neglected
3. Velocity coefficient of nozzle is unity
4. Perfect gas law applies
5. No friction
6. Process is adiabatic
7. Ratio of cross-section at *vena contracta* to upstream cross-section is nearly zero

On this basis, for Houghton's system, v = 284 m/sec, and for the authors', v = 272 m/sec.

Next Q_l/Q_a must be evaluated. Substituting into equation (2):

$$49.9 = \frac{585\sqrt{81}}{284\sqrt{1.18}} + 597\left(\frac{0.02}{\sqrt{1.18 \times 81}}\right)^{0.33}\left(1000\,\frac{Q_l}{Q_a}\right)^{1.5}$$

or:

$$\frac{Q_l}{Q_a} = 0.00093$$

Using this value of Q_l/Q_a in the authors' system,

$$D_v = \frac{585\sqrt{73}}{272\sqrt{1.00}} + 597\left(\frac{0.01}{\sqrt{1.00 \times 73}}\right)^{0.33}(0.93)^{1.5} = 43.8\ \mu$$

5. *Drop-size Distribution for the Authors' Conditions.*—Since this value of D_v is not very different from that obtained from Houghton's data, it appears that his distribution may be used in the authors' case. This is shown in Fig. 6. Had the value of D_v been greatly different, it would have been necessary to use equation (1) to develop the size distribution curve of Fig. 6. In evaluating equation (1), $q = 1/3$, $b = \sqrt[3]{4080/D_v}$, and $a = 1.79 \times 10^{-10} b^{12} V$, where V is the volume of the sample in cubic microns[119].

For a more detailed and rigorous analysis of the Nukiyama and Tanasawa, as well as other spray distribution correlations, the reader is referred to a recent paper by Mugele and Evans[199a].

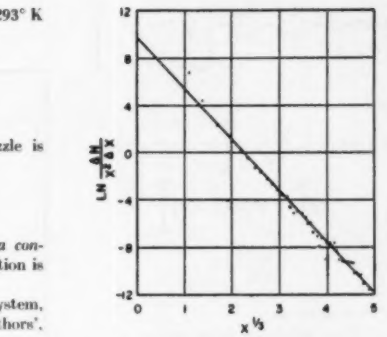

Fig. 5. Houghton's data for a de Vilbiss No. 251 Bulb Atomizer plotted by the method of Lewis, et al. [119]

6. *Evaporation of Drops.*—Evaporation takes place at the surface of the droplets during the course of spraying. Such evaporation, naturally, will eliminate the smallest drops first, while reducing the size of the larger ones. Once the panel has been sprayed for about five seconds, the droplets on the surface will generally have grown considerably in size by agglomeration, so that evaporation is a problem which concerns primarily the droplets from the time they are formed in the sprayer to the time when they arrive at the panel, which is a very brief period of time.

There are a number of equations in the literature for the rate of evaporation of very small drops[194, 195, 196, 197, 198, 201, 202, 203, 204, 205]. The two equations which are the more useful here are those of Langmuir[198] and Bradley[194]. Their applicability is limited by the fact that they are based on evaporation in still air, which is not the case here. However, since we lack the data necessary to make a rigorous calculation of evaporation rates, these equations may serve to indicate order of magnitude.

$$\text{Langmuir:} \quad -\frac{dr}{dt} = \frac{DpM}{RT\rho r},$$

or

$$-r^2 = \frac{2\,DpM}{RT\rho}\,t + c$$

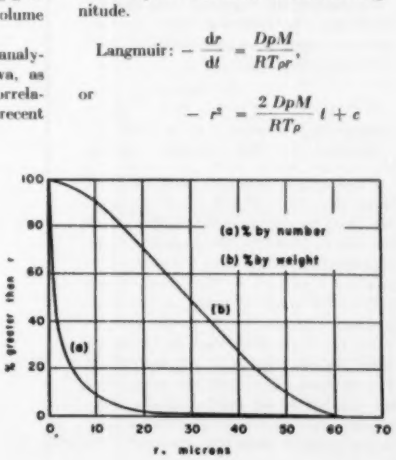

Fig. 6. Drop-size distribution for the atomizer test

Bradley: $$-\frac{dr}{dt} = \frac{DpM}{RT\rho}\left[\frac{1}{\frac{D}{\nu a} + \frac{r^2}{r+\Delta}}\right]$$

or

$$-\frac{2D}{\nu a}r - \left[(\Delta + r)^2 - 4\Delta^2 - 4\Delta r - 2\Delta^2 \ln(\Delta + r)\right] = \frac{2DpM}{RT\rho}t + c$$

Nomenclature:

- D = diffusivity in cm²/sec
- M = molecular weight
- p = pressure of vapor at saturation in dynes/cm²
- R = gas constant in dyne-cm/°K-mol
- r = radius in cm
- T = absolute temperature in °K
- t = time in sec
- a = evaporation coefficient
- Δ = mean free path of air molecules in cm
- $\nu = (RT/2\pi M)^{1/2}$
- ρ = density of liquid in g/cm³

The value of D may be obtained by using the Gilliland equation for gas diffusion coefficients (see Perry's Chemical Engineer's Handbook, for example). This leads to a value of 0.209 cm²/sec for atmospheric pressure, at a temperature of 20° C. At these conditions, Δ is 8×10^{-6} cm. It can be seen that Δ is very small compared to most of the droplets in the spray. Thus, neglecting it leads to only a small error. The Bradley equation then simplifies to the following:

$$-\frac{2D}{\nu a}r - r^2 = \frac{2DpM}{RT\rho}t + c$$

For water at 20° C and atmospheric pressure, $D/\nu a = 0.001^{136}$.

Evaluating the Langmuir and Bradley equations, the following times (in seconds) are required for evaporation of drops of the sizes indicated:

	r in microns		
	1	10	100
Langmuir	0.00137	0.137	13.7
Bradley	0.0284	0.406	16.5

These results indicate, qualitatively at least, that most of the smaller droplets are likely to disappear before they reach the panel. However, the most important consideration with respect to the development of a pattern on the metal surface is the total weight of water, as the droplets which develop on the panels are generally far larger than those in the spray itself. In this connection, it is interesting to note from Fig. 6 that the removal of the smallest 80 per cent of all the drops would reduce the weight of water arriving on the panel by about 2½ per cent.

TABLE X. LABORATORY DATA

A = no. of times solvents have been used. B = pattern type. C = oil coverage in per cent. D = water-break in sec

Cleaning Condition		Cleaning Index in Test				σ	A	B	C	D
Temp °C	Time min	1	2	3	Av.					
Mineral Oil										
100	3	100.0	100.0	100.0	100.0	0.0	1	0	0	Inf.
		100.0	100.0	99.0	99.7	0.6	3	0	0	Inf.
		94.0	95.4	92.6	94.0	1.4	9	1	0	Inf.
		96.5	96.0	87.5	93.3	5.1	10	1	0	Inf.
		48.0	61.8	56.8	55.5	7.0	17	2	0	Inf.
70	3	100.0	100.0	100.0	100.0	0.0	1	0	0	Inf.
		100.0	100.0	100.0	100.0	0.0	4	0	0	Inf.
		94.1	97.6	96.7	96.1	2.6	8	1	0	Inf.
70	10	100.0	100.0	100.0	100.0	0.0	2	0	0	Inf.
		100.0	100.0	99.7	99.9	0.3	4	0	0	Inf.
		80.8	79.4	69.2	76.5	6.3	8	2	0	Inf.
		35.9	41.8	47.5	41.7	5.8	15	4	0	Inf.
70	20	100.0	100.0	99.5	99.8	0.4	1	0	0	Inf.
		96.7	98.3	94.5	96.2	1.5	7	1	0	Inf.
		100.0	100.0	100.0	100.0	0.0	12	0	0	Inf.
		100.0	100.0	100.0	100.0	0.0	13	0	0	Inf.
40	3	33.2	25.6	15.9	24.9	8.7	4	4	0–25	1+Inf.
		28.0	54.2	46.8	43.0	13.5	10	3	0–25	0+Inf.
		41.0	61.0	47.4	49.8	10.2	11	3	0–25	2+Inf.
		24.4	45.7	24.9	31.7	12.1	14	3+4	25–50	0+Inf.
40	10	25.3	64.2	31.4	40.3	21.1	5	4	0–25	Trace
		43.0	47.3	34.3	41.5	6.6	8	3	0–25	Trace
		17.9	22.3	21.4	20.5	2.3	15	5	0–25	1+Inf.
40	20	25.6	35.2	20.2	27.0	7.6	6	4	0–25	2+Inf.
		48.5	43.1	26.7	39.4	11.4	9	4	0–25	Trace
		36.5	51.8	54.2	47.5	9.6	12	3	0–25	6+Inf.
Lard Oil										
100	3	34.0	25.2	34.3	31.2	5.2	2	4A	0–25	2
		18.9	9.8	8.9	12.5	5.5	3	5A	25–50	4
		17.6	34.9	17.4	23.3	10.0	4	4A	0–25	3
		10.9	23.8	25.2	20.0	7.9	13	4A	0–25	3
		26.1	57.0	46.4	43.2	15.7	16	3A	0–25	0
		83.8	78.8	93.0	85.2	7.2	8	2	0–25	0
		(no acid dip in above run)								
100	10	100.0	100.0	100.0	100.0	0.0	1	0	0	Inf.
		98.3	91.1	88.4	92.6	5.1	5	1	0	Inf.
		96.1	100.0	100.0	98.7	2.3	7	1	0	Inf.
		100.0	97.5	96.9	98.1	1.7	12	1	0	Inf.
		90.3	88.1	93.4	90.6	2.7	15	1	0	Inf.
70	3	13.2	13.4	15.5	14.0	1.8	3	3	50–75	0
		0.8	0.0	0.7	0.5	0.4	6	5A	75–100	0
		25.3	14.1	13.4	17.6	6.7	7	5	50–75	0
		2.2	3.7	5.9	3.9	1.9	13	5	75–100	0

TABLE X. LABORATORY DATA (*Continued*)

A = no. of times solvents have been used. B = pattern type.
C = oil coverage in per cent. D = water-break in sec.

Cleaning Condition		Cleaning Index in Test				σ	A	B	C	D
Temp °C	Time min	1	2	3	Av.					
Lard Oil										
70	10	21.0	19.8	23.5	21.4	1.9	3	4A	25–50	1
		10.6	29.2	9.2	16.3	11.2	5	4A	50–75	1
		12.0	23.6	17.1	17.6	5.8	9	4A	50–75	1
		14.0	17.7	15.1	15.6	1.9	14	4A	50–75	0
70	20	32.4	38.8	16.3	29.2	11.6	2	3A	25–50	2
		28.8	37.9	37.6	41.4	14.9	5	2A	25–50	2
		21.9	33.9	31.5	29.1	6.3	9	3A	50–75	1
		66.8	70.7	54.8	64.1	8.3	11	2A	25–50	2
40	20	0.0	0.0	0.0	0.0	0.0	13	6	100	0

(e) *Laboratory Data*

All laboratory data are found in Table X

Values below the dotted lines have not been used in computing averages for Table III since they represent irregularities in procedure.

(f) *Nomenclature*

C.I. = cleaning index = per cent of panel area which is "clean"
Inf. = infinity
L = confidence limit at the 0.05 level of significance
n = number of samples
O.C. = oil coverage
r = ratio of true surface area to apparent surface area
t = test of significance of the value of the mean, or the difference in the value of the means of two sets of samples
$t_{0.05}$ = the value of t for the 0.05 level of significance
T = temperature
W = work
WB = water-break
$\bar{X}$ = mean value of a set of n samples
a = contact angle
a' = advancing contact angle
a'' = receding contact angle
a_m = mean contact angle = $\frac{a' + a''}{2}$
η = viscosity
μ = micron = 10^{-4} cm
ρ = density
σ = standard deviation of the mean for one set of samples
σ = surface tension
θ = time

Subscripts:

a = adhesion
c = cohesion
A = liquid A – air interface
AB = liquid A – liquid B interface
ABS = liquid A – liquid B – solid interface
AS = liquid A – solid interface
B = liquid B – air interface
BS = liquid B – solid interface
L = liquid – air interface
S = solid – air interface
SL = solid – liquid interface

Specialized nomenclature used in equations appearing in Appendix (d), Spraying Characteristics, is defined in that appendix.

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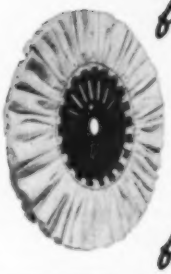

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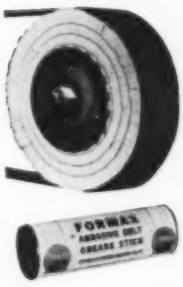

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Book Review

DR. HAROLD J. READ

Associate Professor of Metallurgy, Pennsylvania State College

THE FUNDAMENTALS OF DETERGENCY by William W. Niven, Jr., 1950, v + 256 pages. Reinhold Publishing Company, 330 W. 42nd Street, New York, N. Y. Price, $5.50.

Although this book was written primarily for workers in the field of laundering, many aspects of detergency as discussed therein will be of considerable interest to metal finishers. A major portion of the volume deals in an abstract way with the nature and properties of detergents and with the phenomena which are encountered when they are used in cleaning solutions. Only the last few pages are devoted specifically to the problems of removing soil from fabrics.

The author's approach to the subject is that of the physical chemist, and a modest background in this phase of chemistry as well as organic chemistry is required of the reader. The book is much more specifically directed toward the *problems* of cleaning than the other books on surface chemistry and surface-active agents which have been reviewed in this column during the past several years. Metal surfaces are not discussed, in as much as the cleaning solution *per se* is the subject matter of the book.

The text is largely a review of the literature in the field, but the author has presented this material in a well-organized, coherent form that is easy to read. Most important, however, is his critical attitude toward the literature; he does not hesitate to point out and emphasize inconsistencies and contradictions in the work of various investigators. There is ample evidence of careful study and intelligent selection of the material incorporated into the book.

After reviewing rather briefly the history, nature and properties of detergents, the author discusses the chemistry, surface activity and actions of unbuilt detergent solutions. The same procedure is then repeated for built solutions, with a chapter on electrical phenomena in detergency sandwiched in at an appropriate point. These items comprise about two-thirds of the book; the remainder will be of lesser interest to the metal finisher, although a chapter on stabilization of dispersed soil touches on a matter which has received scant attention in metal-finishing literature. As befits a book of this type, there are numerous references to the literature.

Although the volume would be of no possible use to the man who is interested only in the actual, practical operation of cleaning, anyone who is concerned with the mechanism of cleaning, the compounding of cleaners, or the general phenomena of surface activity will find much of value in the text.

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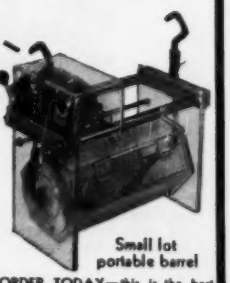

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readers' questions of general interest

Q. 119. Is there any method for plating bright chromium directly on bright speculum metal?

A. This problem has received considerable attention here at Battelle Memorial Institute, but we have not yet arrived at a reproducible method. At the present time, the surest way to accomplish satisfactory appearance is to apply a 60-second bright-nickel plate and then chromium plate.—C. L. FAUST.

Q. 120. Can you give me a formula for a copper solution for backing up silver deposits on mirrors with a low-stress copper plate prior to painting?

A. All copper deposits have relatively low stress. Poor adhesion of copper and silver to glass surfaces is usually associated with improper cleaning of the glass surface or with improper conditions during the copper plating after the silver film has been applied. An ordinary copper cyanide solution with not over 2 oz/gal of copper and relatively low free cyanide, operated at not over 100° F and at relatively low current density, has been used successfully in such an application.—A. K. GRAHAM.

Q. 121. We are able to purchase large stocks of zinc oxide in this country and find it suitable for bright-zinc cyanide plating. Not having any zinc anodes, we use hardened steel anodes. Are any difficulties to be expected in the future? We are contemplating using the same oxide in an acid zinc bath for plating on cast iron. What anodes would you suggest for that?

A. Steel anodes can be used in cyanide baths, notably zinc plating baths. However, they are attacked with formation of ferrocyanide, which causes sludging and, as the concentration builds up, loss of efficiency. There is also a danger of decomposition of cyanides with formation of carbonates.

We understand that silver-99 lead anodes are used in the Tainton process for plating zinc from an acid bath. The zinc content is supplied by zinc ore (your zinc oxide would serve the same purpose) leached with the excess acid formed in the bath during plating with the insoluble anodes. The bath is circulated for the purpose and highly purified after leaching and before return to the plating tank.—A. K. GRAHAM.

A. The difficulties with ferrocyanides are particularly pronounced if any chlorides are present in the zinc bath from dragin of pickling acid or a chlorinated solvent. Anodes of low-carbon steel are likely to be superior to anodes of high-carbon steel.—K. G. SODERBERG.

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Article Abstracts

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Tin Coatings on Steel as a Basis for Protective Painting. S. C. Britton, J. Oil & Colour Chemists' Assoc. **33,** 125–136 (1950).

This paper describes experiments designed to assess the protective value of tin undercoatings on steel. A tin coating applied to steel before painting increases considerably the time elapsing before rust appears and delays very strikingly the spread of rust from areas of damage to the paint. The excellent paint retention on exposure arises from the restraint of under-rusting and the stability of the tin surface.

Methods for the Determination of the Performance of Anodic Oxide Coatings. G. Missier and W. Ruff. Alluminio **19,** No. 6, 515–522 (1950).

The authors have studied experimentally the different methods suitable for determination of the thickness and performance of anodic oxide film on aluminum. The better results can be obtained by weighing or gauging the oxide volume; however, these destructive methods can be adopted for checking other more usual methods only. The tested method were: double microscopic focalization; oxide dissolution; film-thickness determination; weighing; thickness determination on the film detached from the metal by $HgCl_2$; by using a precise micrometer.

Post-Anodic Treatment in the Oxidation of Aluminum. G. Bolognesi. Ann. chim. appl., Roma **39,** 535–541 (1949).

The resistance to dilute hydrochloric acid of anodic films on 99.5 per cent aluminum, pigmented by successive immersion in aqueous inorganic or organic compounds, has been measured by gas-volumetric and electrochemical methods. Barium sulfate, barium chromate, strontium chromate, and urea-formaldehyde markedly increase the protection afforded by the alumina film.

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Sealing of Anodized Aluminum Increases Corrosion Resistance. A. E. Durkin. Iron Age **167**, 96–98 (May 10, 1951).

Anodized aluminum sealed in high purity water with *p*H controlled at or near 6 has approximately 35 per cent more corrosion resistance than when it is sealed in ordinary tap water where no *p*H control is exercised.

Magnesium Alloy Surface Treatment—Importance of Chemical Buffering. L. F. LeBrocq and H. G. Coie. Metallurgia **43**, 256 (February, 1951).

Good buffering is an important practical requirement on chromate treatment baths for the protection of magnesium alloys. Without it, continual additions of acid are necessary to maintain working conditions. The good buffering properties of the hot half-hour chromate bath at *p*H 6 are described in detail. Good buffering of a cold chromate bath at *p*H 4–5 can be obtained by addition of chrome alum or preferably potash alum; the action of alkali on potash alum is examined in detail in this connection. Some commercial baths are well buffered over the working range, and others are not. Extensive use is made of *p*H curves in this work.

New Process Slashes Cost of Phosphoric Acid Pickling. C. F. Paulson and M. E. Gilwood. Iron Age **166**, 97–99 (December 14, 1950).

Describes new ion-exchange process for reclaiming spent acid. By this process, cost of phosphoric acid pickling can be cut 66 per cent. In many cases, cost will be below that of the less desirable pickling with sulfuric acid.

Mechanical Finishing of Metals—For Decorative Purposes. John B. Campbell. Materials & Methods **32**, 81–96 (November, 1950).

Begins with a brief discussion of the selection problem, then considers in turn the processes of polishing, buffing, brushing, tumbling, burnishing, and blasting. Finally, treats in order the mechanical finishing of carbon and stainless steel, aluminum, magnesium, copper, nickel, zinc, precious metals, and high-temperature alloys.

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Sorry to interrupt your correspondence but here are the winners of the Fulton Asphalt Co. ELECTROPLATING KNOW HOW Scholarships: T.J.Manns, plating engineer, Philco Corp.; J.F.Chisholm, dipper, Watertown Arsenal. My thanks to the Fulton Asphalt Co. for making these Scholarships possible and to Judges Blount, Hogaboom, Raymond and Soderberg for selecting the winners, and to the many contestants all over the world!
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Patent Abstracts

GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

Copies of patents may be obtained by writing to Commissioner of Patents, Washington 25, D.C. Price 25 cents each.

No. 2,548,419, April 10, 1951—Method for Production of Lustrous Zinc—Allan E. Chester and David F. Seymour, assignors to Poor and Company, Chicago, Ill.

CLAIM 5. The process of producing a lustrous zinc-surfaced article resistant to corrosion, which comprises immersing a zinc-surfaced article in bath comprising essentially 34 to 46 ounces per gallon of chromic acid, 3.4 to 4.6 ounces per gallon of ammonium persulfate, a stable wetting agent in amounts effective to increase rinsability, the remainder of the bath being water, at substantially room temperature for a period of 1 to 15 seconds, removing the article from the bath and rinsing it, and then immersing the article in an aqueous bath comprising essentially 1 to 1.5 ounce per gallon of sodium hydroxide and 1 to 1.5 ounce per gallon of sodium hydrosulfite at substantially room temperature for a period of 1 to 15 seconds.

6 claims.

References cited: U. S. Patents 2,154,469; 2,186,579; 2,206,064; 2,376,158; 2,433,723. French Patent 737,-433. Swiss Patent 218,087.

No. 2,548,765, April 10, 1951—Method of Producing Electroforms—W. H. Banks, P. B. Upton, J. R. Scott, assignors to The Printing and Allied Trades Research Association, London, England, and the Research Association of British Rubber Manufacturers, Croydon, England.

CLAIM. The manufacture of electroforms by deposition which consists in moulding under pressure a sheet of ebonite composed of natural rubber 73–83 parts and sulfur 19–25 parts and having a yield temperature between 40 and 45° C against a mould of

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1— 300 A., 15 V. Star
1— 750 A., 20 V. M. G. Corp.
1— 800 A., 22/33 V. Gen. Elec.

24 VOLTS
9—1500 A. Century
1—2500 A. Gen. Elec.
3—3000 A. Electric Products

1— 600 A., 24 V. Reliance
1— 200 A., 25 V. Star
1— 300 A., 25 V. Star
1— 175 A., 25 V. Cr. Wh.

32 to 60 VOLTS
1— 500 A., 32 V. Columbia
2— 100 A., 30 V. Gen. Elec.
1— 200 A., 30 V. West.
9— 200 A., 32 V. Gen. Elec.
9—1500 A., 32/40 V. Century
1—1000 A., 33 V. Gen. Elec.
2—1000 A., 40 V. Chandeysson
2— 200 A., 42 V. Gen. Elec.
3—1500 A., 45 V. Century
1—1500 A., 50 V. Gen. Elec.
9— 800 A., 50 V. Gen. Elec.
1— 400 A., 50 V. Gen. Elec.
6—1500 A., 50 V. Century
1—1000 A., 60 V. Gen. Elec.

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● The KOCOUR Chromic Acid Test Set was designed to accurately and simply determine the chromic acid content of chromium solutions. While a hydrometer is sometimes used for this determination, if close control is desired, the solution should be analyzed.

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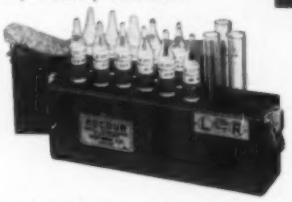

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Patent Abstracts

70–75° C, cooling the sheet to 25 to 30° C, releasing the pressure, chemically depositing a metallic film on the matrix, electrodepositing metal thereon to form an electroform, separating the electroform from the matrix by heat treatment to restore the original condition of the matrix by reason of the latent elastic recovery of the matrix, remoulding the matrix, chemically depositing a metallic film thereon, electrodepositing metal to form a further electroform and separating the electroform from the matrix.

1 claim.

References cited: U. S. Patents 1,588,278; 2,041,743; 2,368,085; 2,400,518. Gottlob's "Technology of Rubber", translated from the 1925 edition and revised by Joseph L. Rosenbaum (1927), pp. 302, 303, 313. T. R. Dawson and B. D. Porritt, "Rubber Physical and Chemical Properties", Research Association of British Rubber Manufacturers (1935), pp. 505, 506.

No. 2,548,867, April 17, 1951—Electroplating Metals—Allan E. Chester, assignor to Poor and Company, Chicago, Ill.

EXAMPLE IV. A plating bath is prepared from the following ingredients:

90 grams of sodium stannate
7.5 grams of caustic soda
15 grams of sodium acetate
0.5 gram of hydrogen peroxide or sodium perborate
Sufficient water to make 1 liter

This bath gives a smooth, white tin deposit at temperatures of 60–80° C and current densities of 15 to 30 amperes per square foot, which is not bright over any range of current densities when direct current is used alone.

With a preferred superimposed current of ac to dc in the ratio of 1:1, bright deposits are obtained within the range of 20–40 amperes per square foot. The calculated valley voltage is approximately −0.0006. The anode current efficiency, which is around 60–70 per cent on quadrivalent tin with direct current, is between 70 and 90 per cent with superimposed ac to dc.

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CLAIM 1. A method of electrodepositing bright plates of metals from alkaline baths which comprises passing electric current including direct and alternating current components of abnormal asymmetric sine wave form having peaks and valleys through an alkaline plating bath of a metal from the group consisting of zinc, cadmium, copper and tin, the valley voltage of the wave being from 0 volts to a minimum of minus two-thirds of the positive peak value, and the alternating current component having a frequency within the limits from about 25 cycles to about 60 cycles.

5 claims, 4 figures, 5 examples.

References cited: U. S. Patents 741,231; 961,924; 1,534,709; 1,918,605; 2,063,760; 2,078,869; 2,143,761; 2,443,599; 2,443,600. Metal Industry (London) **34**, 396–398 (April 19, 1929). Trans. Faraday Soc. **18**, 102–111 (1922); **24**, 348–358 (1929). Monthly Rev. Am. Electroplaters' Soc. **31**, 168 (February, 1944).

No. 2,549,411, April 17, 1951—Electrolytic Stripping of Nickel Coatings from Ferrous Metals—H. M. Bell and E. W. Schweikher.

EXAMPLE 1

NH_4NO_3	100 g/l
$NaHSO_4$, enough to lower the *p*H to	4.0

In this solution, nickel having a thickness of 0.0016 inch was completely stripped in 9 minutes at 3.3 asi current density from polished steel, leaving it bright and in condition to be replated without rebuffing.

EXAMPLE 6

Urea	150 g/l
CrO_3	7 g/l
HNO_3, enough to lower the *p*H to	5.0

In this solution, nickel having a thickness of 0.00185 inch was completely stripped in 14 minutes at a current density of 1.3 asi from polished steel, leaving it bright and in condition to be replated without repolishing.

EXAMPLE 8

Ethylene diamine (100%)	18.75 g/l
CrO_3	31.25 g/l
HNO_3, enough to lower the *p*H to	5.5

In this solution, nickel having a thickness of 0.0017

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For instance . . . take copper-chrome processing in the automotive, accesscry, and lamp industries. Substitute materials problems have caused tremendous loss of production time, machine time, labor and money. Why not bring your finishing problems to us? Our FREE technical and engineering service offers you the answers to your problems. In all probability our research laboratories already have the answers on file.

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THE *Pressure-Cooled* BUFF

* Patent No. 2,519,275. Other U. S. and foreign patents pending.

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Typical small parts finished with tin-zinc plating.

Tin-zinc plating — M & T's new plating process — uses 20% less tin than electrotinning; approximately 60% less than hot-dipping.
Yet, the tin-zinc deposit provides unsurpassed corrosion resistance — excellent solderability — a bright, silvery finish when burnished or buffed. Ease of application and economy are additional features.
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Specialists in Tin and Tin Chemicals
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Why sell your used nickel anodes for scrap? We will reclaim your own nickel anode scrap and convert it into cast oval nickel anodes maximum 36" in length, at a nominal charge. This gives you a considerable saving over the purchase of new nickel anodes, and assures you of a constant supply of anodes.

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AURALLOY
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NEW YORK 3 N.Y.

inch was completely stripped in 27 minutes at a current density of 0.75 asi from polished steel and in a condition to be replated without repolishing.

CLAIM 2. In the stripping of nickel from ferrous metals, the process comprising inserting a ferrous metal article coated with nickel in a stripping bath and passing a direct current from said article, serving as anode, to a cathode; said stripping bath consisting substantially of an aqueous solution of a salt whose anion is that of an oxidizing-passivating acid selected from a class consisting of nitric and chromic acids and whose cation is that of a nitrogen base selected from the class consisting of ammonium hydroxide, guanidine, diethanolamine, triethanolamine, trimethylamine, ethylene diamine, urea, dimethylphenylamine and diphenylmethylamine, said baths having a concentration of said salt ranging from about 50 to 300 grams per liter and a *p*H within the range of from about 3.0 to 6.0.

3 claims, 9 examples.

References cited: U. S. Patents 908,937; 1,314,842; 2,241,585. Monthly Rev. Am. Electroplaters' Soc. **34**, 673–679 (July, 1945). Metal Cleaning Finishing **5**, 464–466 (November, 1933). R. McKay *et al.*, "Corrosion Resistance of Metals and Alloys", p. 250. "Handbook of Chemistry and Physics", 27th ed (1943) p. 1368. Trans. Electrochem. Soc. **69**, 115–123 (1936).

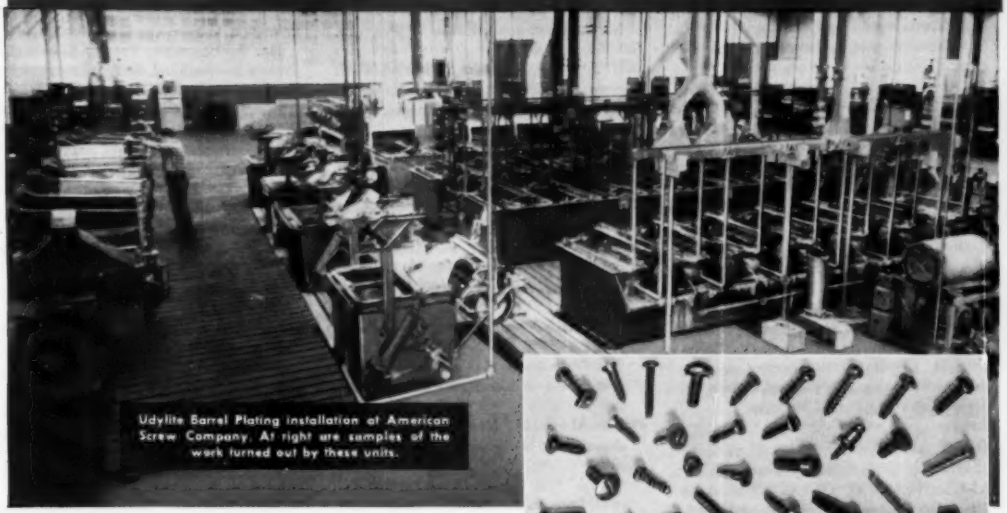
No. 2,549,678, April 17, 1951—Method and Apparatus for Electroforming Metal Articles—R. M. Fiandt, assignor to C. G. Conn Ltd., Elkhart, Ind.

CLAIM 5. Apparatus for electroforming copper horn bells for musical instruments comprising an electrolytic cell to receive electrolyte containing copper in solution, a cathode conforming to the shape of the horn to be formed and a conically shaped anode of inert material arranged concentrically in spaced relation with the cathode but with the taper of the anode being inverse to the taper of the cathode whereby the maximum spaced relation exists in the region of the smallest diameter of the horn and the least spaced relation is in the region of the flared-out bell portion of the horn, means for directing the circulation between the anode and the cathode whereby rapid flow occurs in the region of the flared-out bell portion of the cathode, means supporting the cathode for rotation about a vertical axis, and vanes within the cell attached to the supporting means adjacent the region of the flared-out end portion of the horn, said vanes being angularly disposed to rotate the cathode in response to the fluid flow of the electrolyte as it emerges from the region between the anode and the cathode.

7 claims, 3 figures.

References cited: U. S. Patents 519,595; 680,408; 788,862; 895 163; 903,164; 1,280,249; 1,601 690; 1,862,745; 1,941,376; 2,011,638; 2,129,479; 2,188,472. British Patents 23,679; 429,206; 805,918. Metal Ind. (N. Y.) **25**, 7–9 (January, 1927). Proc. Am. Electroplaters' Soc. **32**, 183, 184 (1944).

NO DOWN TIME IN WEEKS OF ROUND-THE-CLOCK OPERATION with UDYLITE BARREL PLATERS, reports American Screw Company



Udylite Barrel Plating installation at American Screw Company. At right are samples of the work turned out by these units.

Here's a record hard to equal! American Screw Company, Willimantic, Conn., has a battery of Udylite Barrel Platers for zinc, nickel, cadmium and brass plating of screws. The equipment normally operates 16 hours a day but during peak periods is in constant use around-the-clock for weeks at a time with practically no time out for maintenance or repair.

In addition—according to Walton R. Yerger, Metallurgical Engineer—plating results are highest quality, with uniform thickness and luster from lot to lot and day to day. Rejects are virtually non-existent and plating costs have been substantially reduced.

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ALLIED CHEMICAL & DYE CORP. (c)
40 Rector St., New York 6, N. Y.—Any Branch
CLIFFORD STRUYK, General Chemical Division, Edgewater, N. J.
Subject:
Fluoborate Plating Processes

ALLIED RESEARCH PRODUCTS, INC. (c)
4004 E. Monument St., Baltimore 5, Md.—Chicago, Detroit, Bridgeport, Philadelphia, Cleveland, St. Louis, and Indianapolis. Also Atlanta and Baltimore.
Contact H. C. IRVIN, Manager
Subject:
Iridite

ALUMINUM CO. OF AMERICA (c)
New Kensington, Pa.—East, Midwest, Southeast
Contact R. VANDEN BERG, Alcoa Process Development Labs.
Subject:
Electroplating Aluminum Alloys (sound movieslide projector to be furnished by Branch)

AMERICAN CHEMICAL PAINT CO. (b or c)
Ambler, Pa.—East of Mississippi
F. P. SPRUANCE, JR., Chemist, Subjects 1 and 2
ALFRED DOUTY, Chief Chemist, Subjects 3 and 4
Subjects:
1. *Alodine Process for Treating Aluminum*
2. *Preparing Metals for Painting*
3. *Inhibitors of Acid Corrosion*
4. *Phosphate Coatings for Civilian and Military Use*

AMERICAN ELECTROPLATERS' SOCIETY
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For name and address of the President, First Vice-President, Second Vice-President, Third Vice-President, and Past President, see "A. E. S. Directory" in the current issue of PLATING magazine.

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W. C. DIETRICH, Sales Manager, PLATING, Subjects 4 and 5
A. K. GRAHAM, Executive Secretary, A. E. S., Subjects 7, 8 and 9
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2. *Things You Should Know About* PLATING *Magazine*
3. *Operation of the American Electroplaters' Society*
4. *Corrosion Phenomena in Electrodeposits*
5. *The Technique and Significance of Microhardness Measurements on Electrodeposits*
6. *The Mechanical Properties of Electrodeposits as Determined by the Bulge Test*
7. *Things You Should Know About the American Electroplaters' Society*
8. *Substitute Finishes for Critical Plating Materials*
9. *Disposal of Plating Room Waste from an Electroplater's Viewpoint*

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Subjects related to the financing of the A. E. S. Research Program
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DR. A. BRENNER, Project Director of Project 9—National Board of Standards, Washington, D. C.
FIELDING OGBURN, Project Director of Project 13—National Bureau of Standards, Washington, D. C.
DR. EARL SERFASS, Project Director of Project 2—Lehigh University, Bethlehem, Pa.
DR. JOHN KRONSBEIN, Project Director of Project 11—Evansville College, Evansville, Ind.

APOTHECARIES HALL CO. (c)
Waterbury 88, Conn.—New York State and New England
THEODORE VOYDA, Chief Chemist
Subject:
Electroplating Topics

ARMCO STEEL CORP. (c)
Middletown, Ohio—Areas reasonably accessible to Baltimore, Md.
Contact K. M. HUSTON, Senior Research Engineer, Research Laboratories, 3400 E. Chase St., Baltimore, Md.
Subjects:
1. *Surface Finishes for Stainless Steel*
2. *Atmospheric Corrosion of Stainless Steel*

ATLAS POWDER CO. (c)
Darco Department, 60 E. 42nd St., New York 17, N. Y.—Any Branch East of the Rockies
W. A. HELBIG, Chemical Engineer, Sales Department
Subject:
Purification of Electroplating Solutions by Filtration and Activated Carbon Treatment

BATTELLE MEMORIAL INSTITUTE (b or c)
Columbus 1, Ohio—East of the Mississippi
E. R. MUELLER, Supervisor of Coatings Research, Subject 1
DR. C. A. SNAVELY, Assistant Supervisor, Electrochemical Engineering Division, Subjects 2 and 3
J. HOMER WINKLER, Technical Advisor, Graphic Arts Division, Subjects 4 and 5
DR. CHARLES L. FAUST, Supervisor, Electrochemical Engineering Div., Subjects 6, 7 and 8
Subjects:
1. *Organic Finishes for Metals*
2. *Pickling and Waste Disposal*
3. *Metal Finishing Waste Disposal*

4. *Electroforming in the Manufacture of Printing Plates*
5. *Printing Depends on Electrodeposition*
6. *Electropolishing*
7. *Smoothing by Chemical and Electrochemical Methods*
8. *Surface Properties in Basis Metal Preparation*

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New York City District—GEORGE D. BUTLER, 1114 First Ave., New York 21, N. Y.
Atlantic District—DR. E. D. HALLER, 8505 Hazelwood Drive, Bethesda, Md.
Midwest—G. E. KINCAID, 9 S. Clinton St., Chicago 6, Ill.
Midwest—T. F. LAVERY, 103 E. Norwich Ave., Columbus, Ohio
Contact for subject

BEHR-MANNING CORP. (c)
Troy, N. Y.—Any Branch
Contact H. J. SIDFORD, Manager, Sales Promotion
Subject:
Grinding and Polishing with Coated Abrasives

BELKE MANUFACTURING CO. (c)
Contact ALLBRIGHT ASSOCIATES, 166 W. Jackson Blvd., Chicago 4, Ill.
SIGMUND FABRY, Subject 1
RAYMOND KOTZ, Subject 2
HARVEY J. JOHNSON, Subject 3
Subjects:
1. *Plating Racks and Racking*
2. *Transfer Machine, Plating Barrels and Deburring*
3. *Racks and Plating Equipment*

BERKELEY INDUSTRIES (b)
Jersey City, N. J.—Any Branch
MILTON NADEL, Supervisor of Metal Finishing
Subjects:
1. *Surface Finishing of Aluminum and Its Alloys*
2. *Practical Aspects of Plating of Zinc Base and Die Castings*

BETHLEHEM STEEL CO. (c)
Bethlehem, Pa.
Contact S. H. YORKS, Publications Department
Selected subjects
Movie: *Steel-Plus (Versatile Tin Plate—Its Production and Widespread Use)*

BONE ENGINEERING CORP. (b)
701 W. Broadway, Glendale, Calif.
M. H. ORBAUGH, Head, Electroforming Department
Subject:
Military Applications of Electroforming

BRIGGS MANUFACTURING CO. (c)
Detroit 34, Mich.—East and Midwest
Contact HERBERTH E. HEAD, Electroplating Department, 11631 Mack Ave., Detroit 34, Mich.
Subjects:
1. *Electroplating Stainless Steel*
2. *Importance of Proper Design of Plating Racks*

THE BRUSH DEVELOPMENT CO. (c)
3405 Perkins Ave., Cleveland 14, Ohio—North of Ohio River and east of the Mississippi
R. W. COOK, Commercial Engineer
Subject:
Surface Information for the Plater

L. H. BUTCHER CO. (c)
3628 E. Olympic Blvd., Los Angeles 23, Calif.—West Coast
EARL W. ARNOLD, Technical Service Division, Metal Finishing Department
Subject to be selected

THE CARBORUNDUM CO. (c)
Niagara Falls, N. Y.—Any Branch
Bonded Products and Grain Division
Contact J. G. FRITZINGER, Sales Mgr.
Subject:
Polishing Grain and Set-up Wheel Practice
Coated Products Division
Contact F. W. SCOTT, JR., Sales Mgr.
Subject:
Information on Coated Abrasives—Their Manufacture and Application

THE CHEMICAL CORP. (c)
5 Wa tham Ave., Springfield 9, Mass.—East of the Mississippi River
K. P. BELLINGER, Vice-President
Subject
Conversion Coatings for Zinc and Cadmium

DETREX CORP. (c)
P. O. Box 501, Detroit 32, Mich.
Contact L. CAMEL, Sales Manager, Industrial Division
East of the Rockies
L. CAMEL, Sales Manager, Industrial Division, Subject 1
W. H. WEBB, Manager Alkali Division, Subject 2
T. J. KEARNEY, Chief Engineer, Subject 3
W. L. MCCRACKEN, Technical Director, Subject 4
A. H. HARRIS, Division Manager, Subject 5
West of the Rockies
R. B. CARLISLE, Pacific Region Manager, Subject 6
Subjects:
1. *Industrial Product Cleaning*
2. *Alkaline and Emulsion Cleaning Procedures*
3. *The Designing of Cleaning Equipment*
4. *Technical Developments in New Cleaning Chemicals*
5. *New Rustproof Coatings and Their Use as a Substitute for Scarce Metals*
6. *Industrial Product Cleaning*

DOEHLER-JARVIS CORP. (c)
Jarvis Division, Grand Rapids 2, Mich.—Regional meetings in East and Middle West
Contact MAURICE R. CALDWELL, Assistant Vice-President
Subject:
Comparative Protection Obtained by Various Thicknesses of Copper and Nickel upon Zinc, Aluminum, and Magnesium Die Castings

DOW CHEMICAL CO. (c)
Midland, Mich.
Contact ARTHUR SMITH, JR., Director of Public Relations
Topic to be selected

E. I. DU PONT DE NEMOURS & CO., INC. (c)
Electrochemicals Department, Wilmington 98, Del.
Contact H. L. BENNER, Sales Manager, Sodium Products Division, or nearest district office of the Electrochemicals Department
Extension Division, Wilmington, Del.
L. F. LIVINGSTON, Manager
General-interest topics, related to du Pont activity
Finishes Division, 5-237 General Motors Bldg., Detroit 2, Mich.—North of Ohio River and east of the Mississippi
Contact R. C. WILLIAMS, Manager, Automotive Division
Speakers: G. R. MAHER, M. G. PETERSON, G. R. ANGLE
Subjects to be selected
Films (in color): *The du Pont Story*—72 minutes running time
Also a film on research—25 minutes running time

THE DURIRON CO., INC. (c)
Dayton 1, Ohio—Northeastern section of the United States
WALTER A. LUCE, Metallurgical and Chemical Engineer
Subject:
Alloys for Handling Corrosive Plating Solutions

THE ELECTRIC PRODUCTS CO. (c)
1725 Clarkstone Rd., Cleveland 12, Ohio
E. G. SCHROEDER, Sales Manager
Alternate, GORDON J. BERRY
Subject:
Application, Use, and Maintenance of Plating Power Equipment

ENTHONE, INC. (c)
442 Elm St., New Haven 2, Conn.—East of the Mississippi
WALTER R. MEYER, Ph.D., President, Subjects 1, 2, 3, and 4
C. C. HELMLE, Chemical Engineer, Subjects 3 and 4

HUBERT M. GOLDMAN, Chemical Engineer, Subjects 4 and 5
Subjects:
1. *Etching, Bright Dipping and Plating upon Aluminum*
2. *Bright Dipping of Metals*
3. *Preparation of Metals for Electroplating*
4. *Plating upon Aluminum*
5. *Tumble Finishing of Metals*
6. *Engineering Aspects of Plating*

DR. ALFRED L. FERGUSON (b)
Electrochemistry Department, University of Michigan, Ann Arbor, Mich.—Any Branch
Topic to be selected

FORD MOTOR CO. (c)—Any Branch
Manufacturing Research Dept., 3000 Schaefer Rd., Dearborn, Mich.
J. GURSKI, Supervisor, Materials and Processes Section, Subject 1
E. S. COE, Subject 2
Subjects:
1. *Plating Applications to Automotive Parts*
2. *Tin Conservation in Nitriding Stopoff*

Monroe Plant, Monroe, Mich.
J. THOMAS
Subjects:
1. *Plating at Ford Motor Company's Monroe Plant*
2. *Control of Plating Room Wastes*

FORMAX MFG. CORP. (c)
3171 Bellevue, Detroit 7, Mich.—Any Branch
HOWARD J. MCALEER, President
Subject:
Buffing Wheels and Buffing Compounds

GENERAL ABRASIVE CO., INC. (c)
Niagara Falls, N. Y.—North of Ohio River and east of the Mississippi
ROBERT MACDONALD, Vice-President
Subject:
The Manufacture of Electric Furnace Abrasives

GENERAL ELECTRIC CO. (c)
920 Western Ave., West Lynn 3, Mass.—Any Branch
Contact I. A. LEE, Sales Manager, Rectifier Sales Division
Subject:
Rectifiers

GENERAL ELECTRIC CO. (c)
Electronics Park, Syracuse, N. Y.—East and Middle West
GEORGE W. KAVANAUGH, Head of Chemical Section, Electronics Department
Subject:
Corrosion Problems of Interest to the Plater

GENERAL MOTORS CORP. (c)
Brown-Lipe-Chapin Division, Ontario and Marcellus Sts., Syracuse, N. Y.—East
JOHN J. TIERNEY, Supervisor of Process Engineering Department
Topic to be selected

Guide Lamp Division, P. O. Box 1090, Anderson, Ind.—East of Mississippi River
R. W. OYLER, Plating Engineer
Topic to be selected

Oldsmobile Division, Lansing 21, Mich.
R. W. REDMOND, Production Engineer
Subject:
Flat Polishing and Prefinishing of Steel Prior to Electroplating, and in Relation to Buff Operations

Research Laboratories Division, P. O. Box 188, North End Station, Detroit 2, Mich.
WILLIAM M. PHILLIPS, Head of Electro-Chemistry Department
Topic to be selected

GLOVER COATING CO., INC. (c)
376 Washington St., Malden 48, Mass.—East and Northeast
MANSON GLOVER, President
Subject:
Getting Your Money's Worth Out of Tank Linings

W. GREEN ELECTRIC CO., INC. (c)
130 Cedar St., New York 6, N. Y.—East of the Mississippi River; Minneapolis, Minn.; Dallas, Texas; and Houston, Texas
L. W. REINKEN, Chief Engineer
Subject:
About Rectifiers (Questions and Answers)
—Need large blackboard and chalk

FREDERICK GUMM CHEMICAL CO., INC. (c)
538–542 Forest St., Kearny, N. J.—Northeastern section of the United States
A. S. KOHLER, Chief Chemist
Subject:
Barrel Burnishing and Barrel Deburring

HAMMOND MACHINERY BUILDERS, INC. (c)
1600 Douglas Ave., Kalamazoo, Mich.—Any Branch
R. M. BELL, Manager Technical Division
Subject:
Mechanized Polishing and Modern Finishing Trends

HANSON-VAN WINKLE-MUNNING CO. (c)
Matawan, N. J.
Contact JOHN A. BAUER, Sales Dept.
Available speakers: B. C. CASE, R. F. LEDFORD, M. B. DIGGIN, DR. D. G. FOULKE, A. D. SQUITERO
Selected subjects

THE HARSHAW CHEMICAL CO. (c)
1945 E. 97th St., Cleveland 6, Ohio
Available speakers: A. H. DUROSE, A. C. BENNING, DR. M. M. BECKWITH
Topics to be selected. General subjects will be related to electroplating

HAVILAND PRODUCTS CO. (c)
421 Ann St., N. W., Grand Rapids 2, Mich.—Midwest only
JOSEPH M. HAVILAND, Technical Director
Subject:
Chemistry of Metal Cleaning

HOUDAILLE-HERSHEY CORP. (c)
9120 Roselawn Ave., Detroit 4, Mich.—East and Midwest
WALTER L. PINNER, Manager of Research

Chicago Bumper Division, 1455 W. 38th St., Chicago 9, Ill.—Midwest
L. C. BORCHERT
Subject:
Copper, Nickel and Chromium Plating with Special Consideration to Plate Distribution, Testing of Deposits, Anode Studies, etc.

ILLINOIS WATER TREATMENT CO. (c)
Rockford, Ill.—Any Branch
W. S. MORRISON, Vice-President
F. H. KAHLER, Sales Manager
A. C. REENTS, Director of Research
Topic to be selected—would include the application of ion-exchange to the plating industry

INDUSTRIAL FILTER & PUMP MFG. CO. (c)
5900 Ogden Ave., Chicago 50, Ill.—East and Midwest
HAROLD W. FAINT, Sales Manager
Subjects:
1. *Filtration of Plating Solutions*
2. *Water in the Plating Room*

THE INTERNATIONAL NICKEL CO., INC. (c)
67 Wall St., New York 5, N. Y.—East, Midwest and Far West
C. H. SAMPLE, Subjects 1 and 2
WALTER H. PRINE, Subject 3
Subjects:
1. *Specifications and Tests for Electrodeposited Coatings*
2. *Corrosion Behavior and Protective Value of Electrodeposited Coatings*
3. *Industrial Nickel Plating*

KNIGHT PLATING CO., INC. (c)
3143 Bellevue Ave., Detroit 7, Mich.—East and Middle West
W. B. KNIGHT, President and Treasurer
Topic to be selected

JOSEPH B. KUSHNER ELECTROPLATING SCHOOL (b)
115 Broad St., Stroudsburg, Pa.
JOSEPH B. KUSHNER, Director
Subjects:
1. *The Real Secret of Better Plating*
2. *Water Control in the Plating Room*
3. *Dragout and Stream Pollution*
4. *New Developments in Gold Plating*

LESLIE E. LANCY, CONSULTANT (c)
Country Club Drive, Ellwood City, Pa.
Subject:
The Integrated Waste Treatment System for the Electroplating Industry

PENNSALT CHEMICALS

METAL CLEANING DIGEST

for men interested in Metal Cleaning Economies

FAST, DEPENDABLE CLEANING BOOSTS PRODUCTION RATES

Today's stepped-up production schedules demand fast, right-the-first-time work in *all* departments. Cleaning operations are no exception.

A manufacturer of aluminum molding and trim was having trouble meeting production schedules. A little investigating showed that despite an excellent power washer, material was coming through with spots and "etched" pit marks. Naturally this slowed up the whole production line.

SPRAY HEADS CAUSED SPOTTING

At first the cleaner itself was blamed, but then a Pennsalt representative discovered that scale had built up in the spray heads, just enough to cause incomplete cleaning from time to time.

To descale the washer, the make-up tanks were rinsed out and charged with a solution of Pennsalt Cleaner PM-90,® a specialty liquid descaler. This solution was heated to 140°F. and circulated for one hour. Then the washer was rinsed and put back in service. This marked the end of the faulty cleaning, and production rates jumped back to normal.

CLEANER BREAKDOWN PROBLEM SOLVED

And a careful study of cleaning methods did the same thing for a manufacturer of machined and lapped steel castings. The problem here was to clean the parts of steel chips, oils, soil and lapping compound. As production mounted, it seemed impossible to obtain clean, smut-free surfaces, especially after several hours' operation.

There was nothing wrong with the design or application of this plant's one-stage washing machine. However, several different brands of cleaners had been tried, but the high production rate always caused cleaner breakdown. After a careful analysis of all soil and equipment factors, the Pennsalt man recommended the *proper* Pennsalt Cleaner for this specific application. Now all parts come off the conveyor belt clean, hour after hour. Result: Boosted production.

Electronic Products Manufacturer Beats Trichloroethylene Scarcity

Results from a one-minute vapor degreasing operation on coils of wire were not good. A longer exposure to the solvent vapors might have solved the problem, but production schedules had to be met.

A Pennsalt service representative was consulted. After studying the factors, including the characteristics of the drawing lubricant being used for this nickel wire, he recommended a 30-second bath in a 180°F. water solution, containing 4-oz./gal. Pennsalt Cleaner #85.

Results were excellent! The nickel wire came out of the bath bright and clean. Cleaning was faster and less expensive . . . and this manufacturer was able to switch his vapor degreaser to other work.

For Your Lab Notebook

Why Pennsalt Alkaline Cleaners are Based on Fused Materials

1. The various components of the balanced composition are distributed throughout the drum . . . no settling out of heavier particles. In Pennsalt Alkaline Cleaners *each particle* is a balanced formulation.

2. Additions are accurate throughout the drum. Thus you have fewer rejects due to poor balance. For example, poorly balanced solutions frequently leave smut, or cause poor rinsing.

3. Since Pennsalt Cleaners are virtually 100% active ingredients, fusing gives you the advantage of all the components which are balanced for best performance in many different jobs.

Pennsalt PRF® Cement successfully resists even the strongest pickling liquors. The tank pictured handles waste H_2SO_4, HCl, HF, HNO_3 as well as caustic, alkalis and petroleum solvents. Maintenance on this tank, built of acid-proof brick laid in Pennsalt PRF Cement, has been nil for over 5 years.

PENN SALT
Industrial Chemicals

PENNSYLVANIA SALT MANUFACTURING CO.
WIDENER BUILDING • PHILADELPHIA 7, PA.
Progressive Chemistry for over a Century

MAIL THIS COUPON

Please send more information on cleaning

..... (metal)

prior to ..... (Finishing method) (B)

Name .....

Company .....

Address .....

City ..... Zone .... State .....

LASALCO, INC. (c)
2820–2830 LaSalle St., St. Louis 4, Mo.—Any Branch
B. G. Daw or H. J. Struckhoff—Eastern Section
H. J. Struckhoff—Midwest and Far West
Subject:
What Happens in a Plating Barrel

THE LEA MANUFACTURING CO. (c)
16 Cherry Ave., Waterbury 86, Conn.
Dr. Henry L. Kellner, Technical Director—East and Middle Atlantic
Ellsworth T. Candee, Director of Research—East
Subject:
Polishing and Buffing

W. D. MacDERMID CHEMICAL CO. (c)
Box 1041, Bristol, Conn.
E. J. Beloin
Contact for subject

McGEAN CHEMICAL CO. (c)
1040 Midland Bldg., Cleveland 15, Ohio—Middle West
V. H. Waite, Director of Research
Ben Martin, Assistant Director of Research
Address all correspondence to Mr. Waite
Topic to be selected

METAL FINISHING, FINISHING PUBLICATIONS, INC. (c)
11 W. 42nd St., New York 18, N. Y.—New England and Middle Atlantic States
Walter A. Raymond, Engineering Editor
Selected subjects

METAL & THERMIT CORP. (c)
120 Broadway, New York 5, N. Y.—Any Branch
Dr. F. A. Lowenheim
Subjects:
1. *Recent Advances in Tin Plating*
2. *Tin-Zinc Plating*

J. C. MILLER CO. (c)
631 Chestnut St., S. W., Grand Rapids 3, Mich.—Any Branch
W. L. Morgan, Plant Manager and Finishing Engineer
Subject:
Practical Application of Buffing and Polishing (a review of methods and advancement of the subject over the past 25 years)
R. V. Twyning, Vice-President and Director of Research
Subject:
Proper Application of Liquid Buffing Compounds
J. A. Badaluco, Chief Engineer *or*
S. B. Cowdery, Chief Chemist
Subject:
Specialized Equipment and Technique for Zinc Die Cast Plating

MINE SAFETY APPLIANCES CO. (c)
Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.—Any Branch
Contact nearest representative:
F. A. King, District Manager, 1345 Spring St., N. W., Atlanta, Ga.
C. R. Dever, District Manager, 146-148 W. Superior Ave., Chicago, Ill.
J. W. McCrackan, District Manager, 10014–10016 Carnegie Ave., Cleveland, Ohio
H. N. Gruber, District Manager, 87 W. Palmer, Detroit 2, Mich.
J. S. Moore, District Manager, 335 Wall St., Los Angeles 13, Calif.
H. J. Segrave, District Manager, 5-45 49th Ave., Long Island City, N. Y.
B. W. Catalane, District Manager, 1614 Summer St., Philadelphia 3, Pa.
G. W. Lascher, District Manager, 7501 Thomas Blvd., Pittsburgh, Pa.
D. F. McElhattan, District Manager, 257 Rio Grande St., Salt Lake City 1, Utah
B. F. McDonald Co., Agent, 1255 Howard St., San Francisco 3, Calif.
R. A. Pohl, District Manager, 71 Columbia St., Seattle, Wash.
H. W. Richards, District Manager, 1015 S. Cincinnati Ave., Tulsa, Okla.
Movie: *The Air We Breathe*—A 20-minute sound movie, covering the common types of air contaminants found in industrial processes and the personal protective equipment used to prevent the worker from breathing them

MINNEAPOLIS-HONEYWELL REGULATOR CO. (c)
Brown Instruments Division, Wayne and Roberts Aves., Philadelphia 44, Pa.—Any Branch
Contact W. H. Steinkamp, Field Sales Manager
Selected subjects
or, R. R. West, Manager, Equipment Manufacturers Division
Subject:
Temperature Control in Plating Operations

MINNESOTA MINING & MANUFACTURING CO. (c)
8825 Grinnell Ave., Detroit 13, Mich.—Detroit area (100-mile radius)
T. J. Miller, Technical Supervisor—Automotive Trades, Coated Abrasives Division
Subject:
Manufacture of Technical Coated Abrasives Used in Industry and Their Specific Use in Electroplating

GEORGE L. NANKERVIS CO. (c)
19255 W. Davison Ave., Detroit 23, Mich.—Middle West
E. Stadel, Chief Engineer
C. Civan, Project Engineer
Topic to be selected

NATIONAL BUREAU OF STANDARDS (b) and partial (c) under special conditions
Washington 25, D. C.—Any Branch
Dr. Abner Brenner, Subjects 1 and 2
Seymour Senderoff, Subject 3
Dwight E. Couch, Subjects 4 and 5
Fielding Ogburn, Subject 6
Dr. Victor Zentner, Subject 7
Subjects:
1. *Physical Properties of Electrodeposits*
2. *Measuring Adhesion of Electrodeposits*
3. *Measurement of Stress in Electrodeposits*
4. *Electrodeposition of Aluminum from Non-aqueous Solutions*
5. *Electrodeposition of Phosphorous Alloys of Nickel and Cobalt*
6. *Tests and Specifications for Plated Coatings*
7. *Physical Properties of Electrodeposited Nickel*

THE NORTHWEST CHEMICAL CO. (c)
9310 Roselawn Ave., Detroit 4, Mich.—Middle West
Contact B. F. Lewis, Technical Director
Available speakers: B. J. Shatten, Service Engineer; B. Lewis, Technical Director
Subject:
Metal Cleaning Processes

NORTON COMPANY, TECHNICAL SERVICE SECTION (c)
Worcester, Mass.—Any Branch
Subjects:
1. *Abrasives for Barrel Finishing*
2. *Backstand Grinding and Finishing*
Movie: *Grits That Grind—A Story of Modern Abrasives* (Successor to "Norton Abrasives")—Running time 30 minutes

OAKITE PRODUCTS, INC. (c)
22 Thames St., New York 6, N. Y.
Contact Dr. Donald Price, Technical Director
Selected subjects

THE OSBORN MANUFACTURING CO. (c)
5401 Hamilton Ave., Cleveland 14, Ohio
Contact F. T. Turner, Manager Industrial Sales
Selected subjects

PARKER RUST PROOF CO. (c)
2177 E. Milwaukee Ave., Detroit 11, Mich.—Any Branch
F. J. DeWitt, Vice-President
M. B. Roosa, General Sales Manager
R. L. Greene, Assistant Sales Manager
Contact for subjects

PENNSYLVANIA SALT MANUFACTURING CO. (c)
1000 Widener Bldg., Philadelphia, Pa.—Major branches in the industrial Northeast from St. Louis and Milwaukee to Washington and Boston
W. J. Hennessy, Sales Supervisor
A. H. Pope, Technical Service Engineer
Contact for subject

THE PERMUTIT CO. (c)
330 W. 42nd St., New York 18, N. Y.—East and Middle West
A. B. MINDLER, Manager of Market Research
C. F. PAULSON, Market Research Engineer
Subjects:
1. *Demineralizing in Electroplating*
2. *Recovery of Metallic Wastes*

PHILCO CORP. (b)
C and Tioga Sts., Philadelphia 34, Pa.
EDWARD F. OTTENS, Assistant Chemical Engineer
Subject:
Cyanide Zinc Plating—Practical Aspects

POOR & COMPANY, PROMAT DIVISION (c)
851 S. Market St., Waukegan, Ill.—Any Branch
A. E. CHESTER, Director of Research, Subject 1
BRUNO LEONELLI, Detroit Manager, Subject 1
C. L. RICKETTS, Service Engineer, Subject 1
J. T. IRWIN, Chemical Engineer, Subject 2
Subjects:
1. *Present Practices and Probable Trends in Zinc Plating (or Copper, or Cadmium Plating)*
2. *The Acid Phase Preparation of Basis Metals for Electroplating*

RANSBURG ELECTRO-COATING CORP.
Barth and Sanders, Indianapolis 7, Ind.
Contact HAROLD P. RANSBURG
Film: *Electro Painting*—16-mm sound film, 16 minutes running time

ROTO-FINISH COMPANY (c)
3700 Milham Rd., Kalamazoo, Mich.
C. H. CASTLE, Technical Director
Subject:
Mechanical Finishing by the Roto-Finish Processes
Movie on above subject available

SKILLMAN HARDWARE MFG. CO.
Trenton, N. J.—East
EUGENE ZURBACH, Jr., Consultant and Metallurgist, 346 Magee Ave., Philadelphia, Pa. (c) nearby Branches, (b) far Branches
Subject:
Brass Plating

FOSTER D. SNELL, INC. (c)
29 W. 15th St., New York 11, N. Y.—East and Middle Atlantic
DR. FOSTER DEE SNELL, President
Alternate, IRVING REICH
Subject:
Detergency and Surface Activity (with lantern slides)

SOLVENTOL CHEMICAL PRODUCTS, INC. (c)
15841 Second Ave., Detroit 3, Mich.—East and Middle West
Contact H. B. DOWNS, Secretary
Speakers: JAMES EWING and DR. A. A. SCHWARTZ
Subject:
Preparation of Metals for Finishing

SPARKLER MFG. CO. (c)
Mundelein, Ill.
A. C. KRACKLAUER
Subject:
Plating Solution Filtration

STANDARD STEEL SPRING CO. (c)
Coraopolis, Pa.—East and Midwest
G. B. BOWMAN, Chief Chemist
Subject:
The Corronizing Process for Metallic Protection (with lantern slides)

STANDARD-THOMSON CORP. (c)
341 S. Jefferson St., Dayton 2, Ohio—Midwest
LEROY A. CRITCHFIELD, Chief Chemist
Subject:
Quality Control in the Plating Department

FREDERIC B. STEVENS, INC. (c)
1800 Eighteenth St., Detroit, Mich.—East and Midwest
GUY CUMMINGS, Subject 1
A. H. KIRKPATRICK, Subject 2
R. L. EASTMAN, Subject 3
Subjects:
1. *Generators, Rectifiers and Electrical Equipment*
2. *Ventilation and Allied Problems*
3. *Polishing and Buffing Compositions and Their Use*

SULPHUR PRODUCTS CO., INC. (c)
Greensburg, Pa.—Any Branch
WILFRED S. MCKEON, President
Subjects:
1. *Stripping Copper—Non-Dangerously*
2. *Keeping Cyanide Zinc Plating Solutions Cleansed and Purified*

SYLVANIA ELECTRIC PRODUCTS INC. (c)
P. O. Box 6, Bayside, L. I., New York—East
DR. H. BANDES, Subjects 1 and 2
E. R. BOWERMAN, Subjects 3 and 4
Subjects:
1. *Nickel Plating*
2. *Copper Plating*
3. *Plating Room Ventilation*
4. *Alloying of Platings*

TECHNIC INC. (c)
39 Snow St., Providence 3, R. I.—East
FRANK K. SMITH, President
DR. EDWARD A. PARKER, Technical Director
Subject:
Gold Plating

TUMB-L-MATIC, INC, (c) or (b and c) depending on location
4510 Bullard Ave., New York 70, N. Y.
THOMAS L. RENART, Development Engineer
Subjects:
1. *Preparation of Metals for Plating by Tumbling*
2. *Burnishing as a Method for Increasing the Rust Resistance of Plated Articles*

THE UDYLITE CORPORATION (c)
1651 E. Grand Blvd., Detroit 11, Mich.—East and Midwest
WILLIAM JACKSON, Engineer, Subject 1
JOHN DAVIS, Chief Engineer, Subject 2
DR. R. B. SALTONSTALL, Technical Director, Subject 3
Subjects:
1. *Barrel Plating*
2. *Automatic Plating Equipment*
3. *General Electroplating Topics*

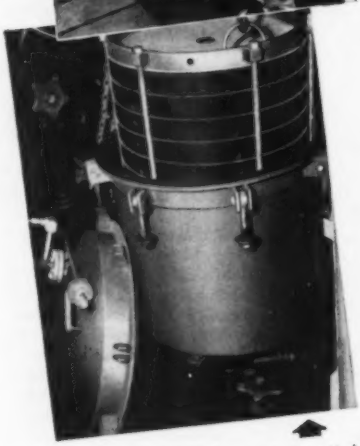
UNITED-CARR FASTENER CORP. (b)
Cambridge 42, Mass.—New England
LEONARD A. CHESWORTH, Chief Chemist
Subject:
Barrel Finishing

UNITED CHROMIUM, INC. (c)
100 E. 42nd St., New York 17, N. Y.—East
R. K. GUFFIE, Subjects 2, 3, 4 and 5
F. FULFORTH, Subjects 4 and 5
J. M. HOSDOWICH, Subjects 1, 4 and 5
H. MAHLSTEDT, Subjects 1, 2, 3, 4 and 5
E. N. RIOTTE, Subjects 4 and 5
Waterbury 90, Conn.—East
DR. G. DUBPERNELL, Subjects 1 and 7
W. GAUNT, Subject 5
M. SHACAT, Subjects 1, 2, 3, 4 and 5
Carteret, N. J.—East
D. MESERVE, Subject 6
F. L. SCOTT, Subject 6
1700 E. Nine Mile Rd., Ferndale Station, Detroit 20, Mich,—Midwest
W. S. CIBULSKIS, Subjects 1 and 2
R. H. DUDLEY, Subjects 1, 2, 4 and 5
HENRY DEWITT, Subjects 2, 4 and 5
J. J. HANNEY, Subjects 2 and 3
A. LINN, Subjects 1, 2, 3 and 4
DR. J. E. STARECK, Subjects 3 and 4
I. M. WEISS, Subject 2
208 S. LaSalle St., Chicago 4, Ill.—Midwest
C. W. CARTER, Subjects 1, 2, 4, 5 and 6
E. M. RELITZ, Subjects 1, 4 and 5
2304 Needmore Rd., Dayton, Ohio—Midwest
E. W. REHME, Subjects 2 and 6
923 E. Third St., Los Angeles 13, Calif.—West Coast
C. G. BORLET, Subjects 1, 2, 4, 5 and 6

UNITED CHROMIUM, LTD., 15 Emily St., Toronto, Ont., Canada—Canada
James GUFFIE, Subjects 1. 2, 4, 5 and 6
Subjects:
1. *Chromium Plating*
2. *Copper Plating from Pyrophosphate Baths*
3. *Electrocolor and Patternplate*

No repairs or maintenance in over 17,000 hours of 'round-the-clock operation

. . . yet this SPARKLER Horizontal Plate FILTER is still going strong



The kind of service Sparkler Horizontal Plate Filters have given the Gillette Safety Razor Company—efficient and trouble-free, even under most extreme conditions—is the kind of service that is vital to *every* filtering operation.

For example: A rubber-lined Sparkler Model 8-18 filter is used by Gillette in the continuous filtration of a 1000-gallon bright nickel plating solution. Now operating for approximately two years, this filter has been on a 24 hours a day, 7 days a week schedule — without any loss of operating time for repairs or maintenance. Also used in periodic batch carbon treatments of nickel solutions this unit, according to Gillette technicians, consistently delivers a brilliantly clear effluent, even though the plates may be packed solid.

Top: Sparkler Model 8-18 filter shown installed in Gillette's plating department. Above: Same filter, with filter plate assembly being removed for cleaning

Left: Sparkler Model 8-6 stainless steel filter. This portable unit is used by Gillette to filter gold plating solutions.

Another Sparkler Filter employed by Gillette is a Model 8-6, stainless steel, portable unit. Used exclusively for cyanide type plating solutions, this Model 8-6 has proved particularly valuable for Gillette's gold plating operations since the patented Sparkler Scavenger Plate assures minimum loss of precious gold solution. Now operating almost six months for at least 2 hours daily, its performance has been satisfactory in every respect.

Our Engineering Department (with more than 25 years' experience in every phase of filtration) is available for consultation without charge.

SPARKLER MANUFACTURING CO.

MUNDELEIN, ILLINOIS

4. *Anozinc and Dip Conversion Coatings for Zinc*
5. *Rack Coatings and Plating Stop-Offs*
6. *Organic Finishes and Protective Coatings*
7. *Plating Literature*

THE UNITED STATES STONEWARE CO. (c)
60 E. 42nd St., New York 17, N. Y.—Any Branch
S. A. LEWIS, Process Equipment Division
Subject:
Controlling Corrosion Problems in the Plating Room

WALLACE & TIERNAN CO., INC. (c)
Newark 1, N. J.—Eastern and Midwestern United States
A. E. GRIFFIN, Director, Technical Service Division
N. S. CHAMBERLIN, Sanitary Chemist, Technical Service Division
H. B. SNYDER, JR., Manager Sewage and Industrial Wastes Sales
Subject:
Cyanide and Chromium Waste Disposal Methods and Equipment

WEIRTON STEEL CO. (c)
Weirton, W. Va.—East of the Mississippi
SAMUEL S. JOHNSTON, Technical Director, Electrolytic Department
Subjects:
1. *Zinc Plating on Wide Strip Steel*
2. *Tin Plating on Wide Strip Steel*
3. *Production of Tin Plate with Differential Coating Thicknesses*

Movie: *Tin Plate*

LOUIS WEISBERG, Consultant
71 W. 45th St., New York 19, N. Y.—Any Branch. Travel expense borne by Dr. Weisberg anywhere except far west
Topic to be selected

WESTINGHOUSE ELECTRIC CORP. (c)
East Pittsburgh, Pa.—Any Branch
Contact GEORGE W. JERNSTEDT, Manager, Electroplating Projects
Subject:
PR Plating and Organic-Free Cyanide Copper Plating
Movies available in any major city through local office

WYANDOTTE CHEMICALS CORP. (c)
Wyandotte, Mich.—East and Midwest
DR. ROY E. HEATH, Manager, Industrial, Railroad & Aircraft Detergents, Subject 1
ROBERT J. RACINE, Manager, Industrial Sales, Subject 2
HAROLD R. SUTER, Director of Application Research, Subject 3
Subjects:
1. *Frontiers in Metal Cleaning*
2. *Behind the Metal Cleaner Label*
3. *Radioactive Tracers in Testing Metal Cleaners*

A. E. S. News

Ventilation Code

Three members of the A. E. S. served on the subcommittee that prepared the American Standards Association's safety code for Ventilation and Operation of Open-Surface Tanks (Z9.1–1951), namely,

S. E. Barr, Western Electric Company

E. R. Bowerman, Sylvania Electric Products, Inc.

M. B. Diggin, Hanson-Van Winkle-Munning Company

Subsequent to the adoption of this code, which is part of a general project known as the Safety Code for Exhaust Systems, Messrs. Bowerman and Diggin were appointed to represent the A. E. S. as liaison and alternate, respectively, to the Z9.1 Sectional Committee on the Safety Code for Exhaust Systems.

The American Standard Z9.1–1951 can be obtained for 75 cents from the American Standards Association, Inc., 70 E. 45th Street, New York 17, N. Y.

Metal Finishing and Electroplating Week

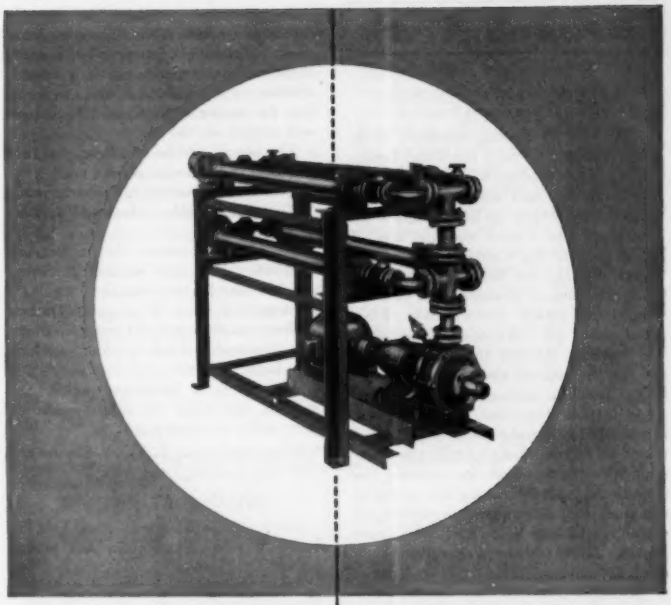
As shown in the Convention Program published in last month's issue, the City of Buffalo honored the A. E. S. by proclaiming the Convention week the Metal Finishing and Electroplating Week. The accompanying picture shows Mayor Joseph Mruk signing the proclamation with

Joan (Mrs. William) Wiarda, Publicity Chairman; Bert Kirchhoff, General Chairman; and William Fotheringham, Co-Chairman, watching the proceeding.

Japanese Publications

Japanese publications dealing with plating are available at the Society's office, but no one there is capable of translating them into English for publication of abstracts in PLATING.

Will any member able to make such translations get in touch with The American Electroplaters' Society, Box 168, Jenkintown, Pa.?

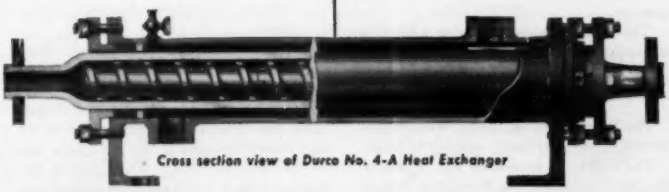


A highly corrosion resistant heat exchanger in a READILY AVAILABLE ALLOY*

The **DURCO** No. 4-A Heat Exchanger efficiently heats or cools corrosive plating solutions.

In this exchanger, the corrosive is in contact only with Duriron parts. The units can be installed either horizontally or vertically, with counter or parallel flow, and permit flexibility of grouping for difficult locations.

***DURIRON** is a high silicon iron, resistant to most commercial acids and other corrosives such as nickel plating, copper plating, chrome plating and anodizing solutions.



Cross section view of Durco No. 4-A Heat Exchanger

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

We will send, on request, Bulletin 1610B giving complete details and specifications.

THE DURIRON COMPANY, Inc.
Box 1019, Dayton, Ohio

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 707.

Branch News

BALTIMORE-WASHINGTON BRANCH

The May 15 meeting consisted of an afternoon tour through the Point Breeze Works of the Western Electric Company.

The 36 members and guests who attended were broken up into groups of six and treated to a most complete tour of all shops. In the Cable Shop we were shown drawing and insulating of copper wire, sheathing of stranded cable with extruded lead jacket, and assembly of coaxial cable for television transmission. On traveling through the Station Shops we saw the making, assembly, and finishing of parts for cable-connecting devices. It is in these shops that the hardware is made and the barrel-plating shop is operated. We finished our tour in the Cord and Wire Shops, where are operated the continuous mills for mixing and applying neoprene and other plastic insulation to wire which had been lead and brass plated. Many additional operations were seen, too numerous to enlarge upon here.

After the tour had been finished, the officers retired to a quiet spot to rest their feet and make arrangements for a summer meeting of officers. At that meeting they plan to discuss the problems before the Buffalo Convention so that the Delegates may be further instructed.

V. J. Hughes, Jr., *Secretary*

BOSTON BRANCH

On May 3, Librarian Narcus presented Mr. Manson Glover of Glover Coating Company, Malden, Mass., as the speaker. Mr. Glover held the attention of his audience with a general discussion of "Organic Tank Linings": what to use, when to use it, why to use it, and how to keep the tanks in condition. Sprayed rubber, rubber sheet, Koroseal, thermosetting coatings, thermoplastics, and plastisols were discussed in some detail. Positioning of tanks with relation to exposure to heat and cold were well illustrated by practical installations. Troubles arising from improper use were illustrated by examples of problems arising in shop practice.

The meeting adjourned after a lengthy discussion period.

George P. Swift, *Secretary*

BOSTON BRANCH

The Branch met on June 7, with President Chesworth finally coming to hand.

The Librarian presented Mr. Lord of the Norton Company, Worcester, Mass. His talk about "Abrasive Tumbling" was quite lengthy but full of interesting points and illustrated by a number of colored slides for comparison of what could or could not be expected to happen with proper use of abrasives. Types of barrels, alkaline or acid compounds, brighteners, pollution of water, and the like were discussed as separate items. The color slides also gave an insight into practical installations. Some experiences as a trouble shooter were brought out, and the necessity for proper utilization of equipment and control was shown.

The annual election of officers was held and gave the following result:

President—Leonard A. Chesworth
First Vice-President—James H. Anderson
Second Vice-President—Myer Shapiro
Secretary-Treasurer—George P. Swift
Librarian—Harold Narcus
Sergeant-at-Arms—William E. Dailey
Board of Managers—Manson Glover, Chairman; Andrew W. Garrett, Louis J. Love

After a short discussion period, the meeting adjourned for refreshments of beer, coffee and sandwiches.

George P. Swift, *Secretary*

BRIDGEPORT BRANCH

A special business meeting was held on April 20 with 25 members and guests present.

Three new members were elected, and three membership applications were received. One member, no longer connected with the plating industry, resigned.

Librarian Richard C. Barrett reported that no open meeting would be held in May because of the Spring Dinner-Dance on May 25, but that a business meeting would be held on May 11 with installation of officers and delegates and with a round-table discussion.

The annual elections were held and gave the following results:

President—Mederick J. Brassard
First Vice-President—Raymond W. Goral
Second Vice-President—Virgilio S. Consalvo
Secretary-Treasurer—Joseph G. Sterling
Librarian—Philo Bailin
Sergeant-at-Arms—Michael Lombard
Board of Managers—William Thompson, William Flaherty, William A. Ehrencrona, Anthony J. Chenis
Delegates—George J. Eckholm, Mederick J. Brassard, Joseph G. Sterling
Alternate Delegates—Virgilio S. Consalvo, Charles L. Temple, Arthur R. McNeil

After considerable thought and discussion, the Branch members voted *no* to any resolution raising the per-capita tax at the present time. They are of the opinion that if funds are needed they can be procured by better advertising of Plating or by economy in spending money. The Secretary was ordered to write to the Executive Board and the Branches to this effect.

President A. J. Chenis has appointed William A. Ehrencrona Chairman of the Dinner-Dance Committee. Mr. Ehrencrona will appoint his own committee.

The Secretary agreed to notify all prospective members of their induction into the Society and request their presence.

Refreshments and sandwiches were served, courtesy of A. R. McNeil of MacDermid, Inc., Waterbury, Conn.

Jos. G. Sterling, *Secretary-Treasurer*

CHICAGO BRANCH

The last education session prior to the summer vacation period, on June 8, featured an excellent talk on "Anodizing of Aluminum" by Mr. R. E. Pettit, General Manager of Chicago Thrift-Etching Corporation. The interesting discussion period which followed gave evidence of Mr. Pettit's many years of experience in the finishing of aluminum, and the keen interest of the audience in this timely subject.

An entertainment committee was activated recently for the purpose of adding an appropriate sugar coating to the educational program. The enthusiastic reception of the committee's first efforts, in the form of a Singer-Accordion player, indicated that this may become a regular part of the educational program.

R. E. Harr, *Correspondent*

Hartford Branch Business Meeting. Left to right, top: Messrs. Santoro, Kelly, McInerney, Platos, Backus: middle: Messrs. Hickey, Colombie, Savarella, Sanders, Palon, Dankevitch, Cullen; bottom: Mr. Cullen, Julia Madzik, Messrs. Hancock, Smith, Hogaboom, Chace and Beloin

DALLAS-FORT WORTH BRANCH

On June 14 the Branch was the guest of the Falcon Manufacturing Company, in its new plant at 148 Fordyce Street. All members and visitors went on a tour through the plant, after which all assembled in the large office for a well attended meeting.

In absence of the President, First Vice-President C. P. Lavell dispensed with business at hand.

Mr. H. C. Irvin, President of Allied Research Products, Inc., Baltimore, Md., gave a very interesting talk and displayed samples of Iridite-treated zinc and aluminum. Everyone enjoyed the presentation.

C. A. White, *Secretary-Treasurer*

HARTFORD BRANCH

The business meetings during 1950–1951 have all been held in the recreation room in the cellar of the home of Arthur W. Logozzo, A. E. S. Past President. The pictures on page 878 record one of these occasions. The host, Mr. Logozzo, being the photographer, did not get into any one of them.

LOS ANGELES BRANCH

Over 100 members and guests, one of the best turnouts of the year, enjoyed the usual excellent dinner and a very fine talk on June 13.

Dr. Charles L. Faust of the Battelle Memorial Institute was the speaker and presented an excellent discussion of "Surface Preparation by Means of Mechanical, Chemical and Electrochemical Methods". He stressed the difference in surfaces produced by mechanical means and by other methods. Electropolishing is used quite widely in the East to produce a pleasing appearance, for machining purposes, for sizing because of uniform metal removal, and for additional corrosion protection. Most of the solutions are combinations of sulfuric, phosphoric, and chromic acids. Installations vary in size from 50 gallons to 24,000 gallons, and the highest single customers' output is of the order of one million pieces per month.

Costs, usually 5–12 cents/sq ft, are found comparable with those of hand polishing and buffing for a usable, but not necessarily identical result. On wheel-polished surfaces, lightly connected metal particles can give rise to subsequent roughness in electroplating. Chemical and electrochemical methods do not roughen the surfaces.

Chemical polishing may be readily used to prepare copper for subsequent chromium plating, with excellent results. Aluminum may also be treated by chemical or electrochemical means to produce bright surfaces. Methods have been developed for silicon-free cast alloys, which will not reduce surface roughness but will brighten the surface. A smooth, reflecting surface may be produced from polished pieces having nothing worse than a No. 180 grit scratch. The slides indicated the influence of grain size on subsequent finishing, also that the surface must be free from nonmetallic inclusions. An exhibit of parts illustrated further the results and applications.

The active interest of the members in Dr. Faust's presentation was indicated by the extremely lively discussion.

Five new members were received.

G. Stuart Krentel, *Secretary*

MELBOURNE BRANCH

Forty members and visitors attended the 62nd regular meeting on June 21 at the Melbourne Technical College.

Films starring Charlie Chaplin and W. C. Fields were followed by a more technical film dealing with sewage disposal. Committeeman John Dale introduced the speaker, Mr. A. Gardner, Sewage Engineer of the Department of Supply, whose subject was "Waste Disposal". The treatment of sewage as carried out in Melbourne, country centers, and overseas was outlined by the speaker, who pointed out how different types of industrial wastes could affect the type of treatment plant. He mentioned possible means for the elimination of metals, acids, and cyanides, and suggested that platers consider the use of separate acid and alkaline waste-disposal systems. The use of reclaim tanks and of lead floors to collect spillage was also suggested.

During the discussion it was pointed out that marble chips in a neutralizer

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The U. S. Stoneware Co. can supply all necessary materials for installation by your own workmen of a "triple-construction" acid-and-alkali-proof floor, or if you desire, we can handle the entire job, including labor and materials.

could easily be cleaned if stored in a stainless-steel basket which can be lifted out and hosed. Other points stressed were the danger of cyanide poisoning and the importance of an effective rinse system.

ROWLAND H. KELLER,
Honorary Secretary

MILWAUKEE BRANCH

The many members and guests who attended the June 8 meeting enjoyed an evening of discussion and entertainment.

Those sterling gentlemen who conducted the Annual Meeting, TED HARTSHORN, GLEN SCHWEMER, VINC MATTACOTTI, BOB STEUERNAGEL and their committees, received an ovation for their excellent work.

PRESIDENT L. DIVELEY reviewed the achievements of the Branch during the past year and stressed the need for a continued drive to bring more young platers into the organization. The Branch had had a 20 per cent increase in membership and a 50 per cent increase in attendance. An excellent educational program, prominent speakers, and active membership participation contributed to the success of the year's activities.

The members voted to act as a Committee on the Whole, with V. MATTACOTTI as Chairman, for the discussion of the proposed per capita-tax increase. The Delegates were made aware of the members' feelings on the subject and were instructed to consider the proposals that will be presented and vote accordingly.

DEXTER RHODES installed the newly elected officers and urged them to continue the excellent program begun by their predecessors.

After a vote to adjourn, the newly elected President, EVERETT ROBINSON, invited the members and guests to enjoy the surprise entertainment—and surprising it was, too! Refreshments were contributed by the Redi-Products Company. The door prize, an electric knife sharpener, was donated by the John Oster Manufacturing Company.

E. E. PIELLUSCH,
Secretary-Treasurer

NEWARK BRANCH

The regular meeting of the Branch was held on Friday evening, May 18, at the Hotel Robert Treat.

Three membership applications were voted to take the regular course. Three men were elected to membership, and three members resigned.

ROBERT HORROCKS reported that an Educational Committee meeting was held on May 10 and that another Committee Meeting would be held at the conclusion of this meeting to complete arrangements for the 1951–1952 program.

The Secretary reported that MYRON B. DIGGIN was seriously ill, and that HORACE SMITH was recovering from his illness.

HONORARY MEMBER ROYAL F. CLARK, SR., gave a short talk on his plating experiences at the turn of the century. Guest speaker for the evening was DR. K. SCHUMPELT of Forstner Chain Corporation, whose subject was "The Plating of Precious Metals". His main topic was plating of gold alloyed with copper, silver and nickel. He illustrated with slides their effect on the gold deposits. His lecture proved very interesting.

Sixty-two members attended.

GEORGE WAGNER, *Secretary*

PHILADELPHIA BRANCH

A regular Branch meeting was held on May 25 at the Harrison Laboratory of the University of Pennsylvania with 36 present.

ROBERT TIERS, Chairman of the Branch Research Finance Committee, reported that a letter sent out in March to 20 prospects in the Philadelphia area had produced good results with sustaining memberships being received from three firms.

WILLIAM MOYER of The Udylite Corporation introduced the speaker, MR. L. R. EASTMAN, Frederick B. Stevens, Inc., whose subject was "Polishing and Buffing Compositions and Their Use". Covered were typical polishing and buffing cycles on various parts, and operations, equipment, wheels, buffs and compositions. To conserve plated metals, he recommended reduction of the usual buffing speeds and the use of solter wheels with less abrasive compounds.

The Board of Managers presented a motion recommending to the Delegates that they reserve their vote on any increase in dues or per capita tax until need for such increase or increases has been shown by an audit of the Supreme Society's books. The motion carried.

A motion was passed that the Delegates be uninstructed regarding their vote for Third Vice-President.

Two active members were admitted.

I. WM. MARCOVITCH, *Secretary*

PITTSBURGH BRANCH

The Branch held its regular monthly meeting at the Sheraton Hotel on March 8 with 19 members attending the dinner and 40 members present at the meeting itself.

One membership application was submitted, and four new members were elected.

The dues increase from $8.00 to $10.00, suggested by the Boston Branch, was discussed. It was decided that Delegates go uninstructed to the Convention and use their own good judgment in this matter.

W. S. MCKEON and JOE WEIGAND were elected Honorary Members. They are the only charter members of the Branch.

The following officers were elected for the 1951–1952 term:

President—R. A. WOOFTER
First Vice-President—R. J. GOLDBACH
Second Vice-President—E. B. WASHBURN
Secretary—R. H. SCHINDLER
Treasurer—DAMON ANTEL
Librarian—R. E. VARNER
Board of Managers—E. J. SMITH

The three delegates for the National Convention are FRANK KELLER, S. S. JOHNSTON and ED WASHBURN, with LEO SCHMITT, SR., R. A. WOOFTER, and CARL YERGER, alternates.

MR. WILLIAM JACKSON of The Udylite Corporation, the speaker for the evening, gave a very interesting and informative lecture on "Barrel Plating Technique".

R. H. SCHINDLER, *Secretary*

PITTSBURGH BRANCH

In keeping with tradition, the Branch held its Annual Ladies' Night Banquet on April 14. Over 200 people gathered at the Main Ballroom, Hotel Sheraton, and enjoyed a delicious ham-steak dinner, followed by a floor show and dancing to the music of Slim Bryant and his Orchestra, of radio and TV fame.

PRESIDENT ED SMITH presented the scrolls of Honorary Membership to our two charter members, JOSEPH WEIGAND and W. S. MCKEON.

The festivities continued until a late hour, and all present agreed that it was one of the most enjoyable affairs they had attended. The success of the evening was in large part due to the efforts put forth by the Banquet Committee, which consisted of K. K. CARPENTER, Chairman; P. R. CARR, JAMES J. GLASS, R. J. GOLDBACH, ARTHUR KAUPE, P. B. MCCLOSKEY, W. B. WILLIAMS, G. S. WOODRUFF, R. E. VARNER, and J. D. PATRICK.

R. A. SCHINDLER, *Secretary*

PITTSBURGH BRANCH

The Branch held its final meeting of the 1950–1951 term on May 10. The business meeting was preceded by a dinner, at which several members of the Electrochemical Society were present. It has been the custom of the Branch to designate the May meeting as a joint gathering for the A. E. S. and the E. S.

The committees which had been active throughout the year presented their reports, and they were commended for their successful efforts. R. VARNER gave the final report on the successful Annual Banquet. PRESIDENT ED SMITH gave a report of his very successful term in office, and was given a rising vote of thanks for his tireless efforts. SAM JOHNSTON then installed the officers for the coming year.

The speaker of the evening, DR. JOHN KRONSBEIN, Evansville College, gave a very interesting lecture on "The Use of Radioactive Isotopes for the Determination of Current and Metal Distribution in Electrodeposition". The question period following the main talk was exceedingly lively and informative, and everyone present agreed that it was one of the most

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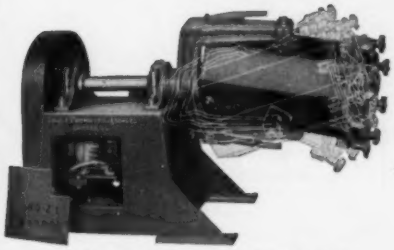

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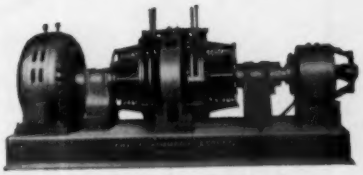

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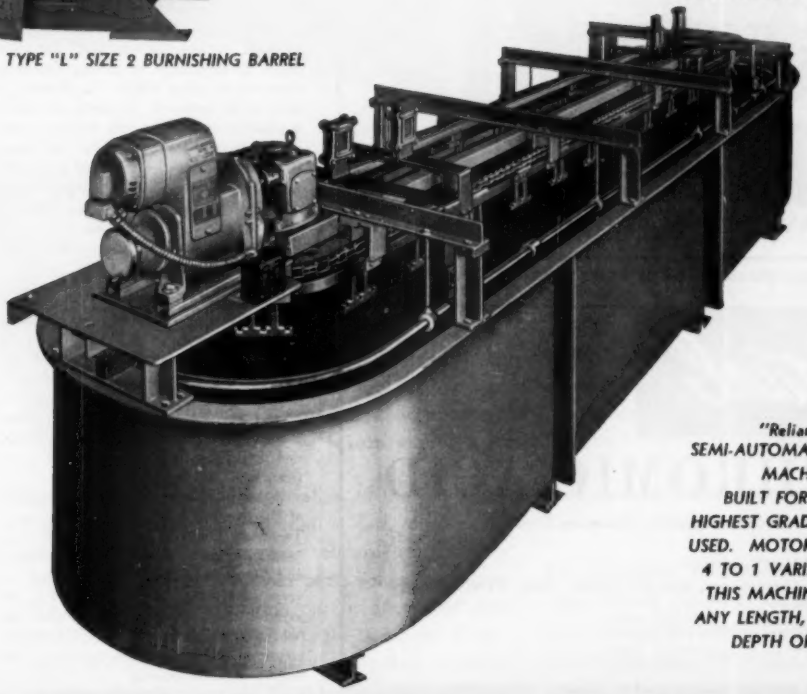

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Branch News

valuable educational sessions of the year.

The balance of the evening was spent in social activities accompanied with refreshments.

R. H. SCHINDLER, *Secretary*

PROVIDENCE-ATTLEBORO BRANCH

The May meeting was called to order by PRESIDENT ALFRED MARSHALL, with 27 members present.

JOHN HENRY reported that the Spring frolic would be held June 18 in the Veterans of Foreign Wars Hall, Attleboro, Mass. RAY MITCHELL was presented with a Past President's pin.

The speaker of the evening, MR. MARTIN MAHER, Oakite Products, Inc., gave a very informative and interesting talk on the cleaning of low carbon steels prior to electroplating or organic finishing. In his talk he brought out that the most rapid developments in plating processes have taken place within the lifetime of most of his listeners. A goodly portion of a plater's troubles are the result of poor preparation of the base metal, and there is a trend in the cleaning field to double up on the cleaning cycle, thereby adding a safety factor and extending the life cycle of the cleaning material.

F. W. BOOTHROYD, *Secretary*

ROCKFORD BRANCH

The May meeting was held at the Faust Hotel with 26 on hand for dinner and 32 for the technical session.

Committee reports were presented concerning the arrangements for the June picnic. PRESIDENT DALE CHAPMAN reported the letters received from other Branches concerning per capita tax. Three new active members were admitted to the Branch.

BILL GEISSMAN presented our speaker of the evening, DR. R. B. SALTONSTALL, Technical Director of The Udylite Corporation. He spoke on "Modern Trends and Developments of Electroplating", a very interesting lecture which was enjoyed by all. A discussion period was held after the lecture and Dr. Saltonstall answered many questions concerning the history of electroplating.

KEN KIESELBURG,
Secretary-Treasurer

SYDNEY BRANCH

In the absence of PRESIDENT MURPHY, L. MILLER acted as Chairman at the 73rd regular meeting on June 14.

The educational period was taken up by a question-box and general-discussion session. As usual, some lively arguments took place.

J. TAYLOR was elected First Vice-President instead of J. R. PHILLIPS, who was forced to resign by ill health.

W. W. PATERSON,
Secretary-Treasurer

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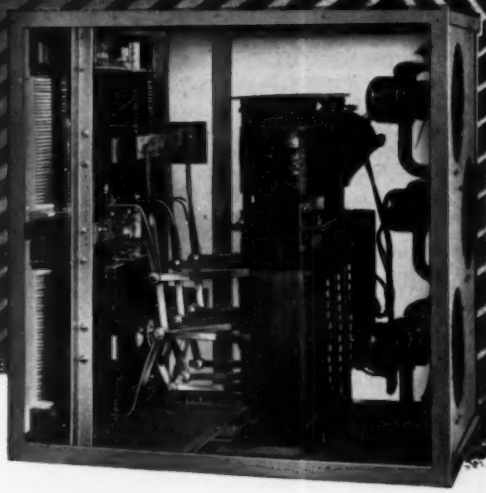

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Membership Report of the A. E. S.

Elections

ADELAIDE: J. M. Angove, K. F. Davey, B. Footner, K. C. Lindner, R. T. Milner, S. W. Read

BALTIMORE-WASHINGTON: W. J. Hays, M. E. Shaff, C. E. Whitfield, Sr.

BOSTON: J. L. Albertini, P. J. Barbera, J. C. Borsetti, J. E. Cooper, A. Duffy, J. P. Gill, E. C. Gratto

BRIDGEPORT: F. E. Adams, J. Lehner, L. J. Standish

BUFFALO: J. J. Ciresi, F. H. Sapp, G. H. Smith, A. B. Vick

CHICAGO: H. A. Delihant, L. F. Duncan, V. P. Casperson, W. H. Farmer, R. D. Giesel, W. C. Hammill, E. L. Jacobsen, C. H. McComb, C. P. Olsen, J. H. Oxley, D. L. Patterson, E. C. Prafke, H. H. Stelter, H. K. Stelter

CINCINNATI: J. G. Beck

CLEVELAND: F. Ezzo, Jr., F. Henry, J. X. Kreizwald, R. I. Peters, E. S. Porter, M. B. Schramm, N. Zinni, R. Zulak

DETROIT: A. O. Bragg, W. Cibulskis, R. N. Lipson, R. Mallen

LOS ANGELES: J. G. Buchanan, J. P. Bylinowski, W. M. Crawford, E. R. Nicodemus, H. P. Wanamaker

MELBOURNE: C. Collins, B. Cox, N. Davey, S. E. Ellis, G. R. Isaac, G. Little, C. Williams

MILWAUKEE: N. Ternosky

NEWARK: A. Butbe, S. Geffon, F. Somlo

MONTREAL: A. W. Picton

NEW YORK: J. Aisley, J. Barsky, E. Cicio, R. E. Dieckman, S. Fuhr, A. M. MacKey, G. S. Morrison, E. C. Smith, E. M. Tinnon, A. Zminkowski

PHILADELPHIA: R. S. Benjamin, F. J. Holt, W. J. Jondreau, C. B. Ricca, J. L. Roberts, Jr., J. R. Ross

ROCKFORD: C. Bernatz, W. W. Fox, R. W. Johnson, H. C. Steinke, H. P. Thomen, Jr., A. F. Weinkauf

SAN FRANCISCO: G. T. Edmonds, W. Gray, R. V. Zimmerman

SYDNEY: A. E. Fowler

SYRACUSE: A. A. Gutekunst, M. Ihrie, J. J. Keers, Jr., J. A. Leo

WATERBURY: A. A. Kinkel, D. H. Yard, Jr.

WESTERN ONTARIO: C. Bolt, A Campbell, E. Powers, C. Young

MEMBERSHIP-AT-LARGE: W. Pfanhauser, J. Riley, B. Sylvester, F. Wild

Reinstatements

BOSTON: F. C. Koury, C. McNally

CLEVELAND: Sylvester G. Domen

INDIANAPOLIS: M. Malvase

Membership Competition

BRANCH	Membership Apr. 1, 1951*	New Members	Net Change in Membership	Per Cent Net Change
First Group				
Chicago	409	29	+26½	+ 6.5
Melbourne‡	126	8	+ 7	+ 5.6
Boston	151	7	+ 7	+ 4.6
New York	279	11	+12½	+ 4.5
Cleveland	205	8	+ 7	+ 3.4
Milwaukee	143	6	+ 4	+ 2.7
Bridgeport	152	6	+ 4	+ 2.6
Philadelphia	201	6	+ 5	+ 2.5
Los Angeles	211	7	+ 5	+ 2.4
Detroit	492	9	+ 6½	+ 1.3
Waterbury	126	2	+ 1	+ 0.8
Pittsburgh	132	..	+ 1	+ 0.8
Newark	239	3	+ ½	+ 0.2
Hartford	137	3	.....	.....
Grand Rapids†	164	..	− ½	− 0.3
Second Group				
Rockford	67	6	+ 6	+ 9.0
Syracuse	85	6	+ 7	+ 8.2
Buffalo	85	6	+ 5	+ 5.9
Baltimore-Washington	87	5	+ 4½	+ 5.2
St. Joseph Valley	71	1	+ 1	+ 1.4
Indianapolis	92	..	+ 1	+ 1.1
Dayton	82	..	.....	.....
Rochester	88	..	.....	.....
St. Louis	105	..	.....	.....
New Haven	108	..	.....	.....
Toronto	121	..	.....	.....
Providence-Attleboro	100	..	− 1	− 1.0
Cincinnati	88	1	− 1½	− 1.7
Montreal	77	1	− 4	− 5.2
Sydney	93	1	−15	−16.1
Third Group				
Dallas-Fort Worth	31	5	+ 5	+16.1
Houston	25	..	+ 1½	+ 6.0
Southeastern	48	2	+ 2	+ 4.2
Springfield	54	2	+ 2	+ 3.7
San Francisco	65	3	+ 1	+ 1.5
Lancaster	60	1	.....	.....
Louisville	23	..	.....	.....
Hamilton	25	..	.....	.....
Jackson-Lansing	52	..	.....	.....
Columbus	54	..	.....	.....
Saginaw Valley	57	..	.....	.....
Twin City	66	..	− 1	− 1.5
Toledo	45	..	− 1	− 2.2
Allentown-Reading¶	42	..	− 3	− 7.1
Adelaide	65	6	− 6	− 9.2
Western Ontario	23	4	− 6	−26.1
Outside Competition				
At Large	120	5	+ 5	.....
In Transfer	16	..	+ 4	.....
Total A. E. S.	5,387	160	+92	+ 1.7

Active Membership, July 1, 1951 5,479

*Subject to correction. †, ‡, ¶Winners in first, second and third group, respectively, of 1950–1951 membership competition.

NEWARK: M. Mazzone
NEW YORK: O. Brill, D. Price
PITTSBURGH: J. A. Fletcher
SAN FRANCISCO: F. Cavallera, S. Herrick, J. Levoy, G. Pilaro, G. A. Rodrigues, R. L. Ruggieri
SYDNEY: J. W. Bridge, I. G. Maddams, G. Potts, M. Roach
SYRACUSE: G. M. Whitney, Jr.

Transfers

L. M. Rasmussen from Cincinnati; F. Harris from Baltimore-Washington; J. Baker, Jr., from Detroit; D. J. Gentile from Detroit; G. A. Lux to Newark

Resignations

ADELAIDE: R. W. Barker, F. G. M. Byles, A. V. Capel, M. Grosser, A. H. Nash, P. Nolan, F. Ridge, E. J. Woodcock, A. F. Wells
BOSTON: J. M. Colonas, C. F. Gurnham
BRIDGEPORT: H. E. Conner
CHICAGO: E. S. Schmeling
LOS ANGELES: F. P. Geibel, J. T. P. MacDonald
MILWAUKEE: W. J. Cotton, H. C. Stewart
MONTREAL: C. C. Charest, S. J. Chick, G. R. Hastings, L. Leblanc
NEWARK: M. A. Durso, P. Labash, J. M. Verzier
PROVIDENCE-ATTLEBORO: J. A. Wade

Suspensions

ADELAIDE: H. C. Bowra, H. K. Kahan, F. McIntyre
ALLENTOWN-READING: J. McCurley, J. Perotto, C. R. Seaman
BUFFALO: W. H. Sutton
CLEVELAND: R. E. Shope
SAN FRANCISCO: F. Diem, R. Fellom, Jr., R. Karczynski, J. J. Meehan, J. H. Strasser, M. Vrilakus, W. Weston, A. Wilkinson
SYDNEY: L. Aldrige, J. W. Bridge, G. Brown, S. S. Cook, J. R. Godfrey, M. W. Hall, P. H. Justo, J. O. Kolts, F. V. Kulmar, J. H. Lean, G. Minnis, G. Potts, A. M. Reeves, F. Rixon, L. L. Smith, C. J. McSweeny, A. H. Talbot, R. Wiles
WESTERN ONTARIO: E. F. Cygan, R. T. Dufour, W. J. Dunlop, E. T. Fergusson, H. H. Hind, M. McDonald, D. E. Patton, R. A. Rawlings, D. C. Smith, J. Volkes

Deaths

HARTFORD: W. J. Schiffer
MONTREAL: H. Harding
NEWARK: W. J. Devoti
TWIN CITY: E. W. Presser

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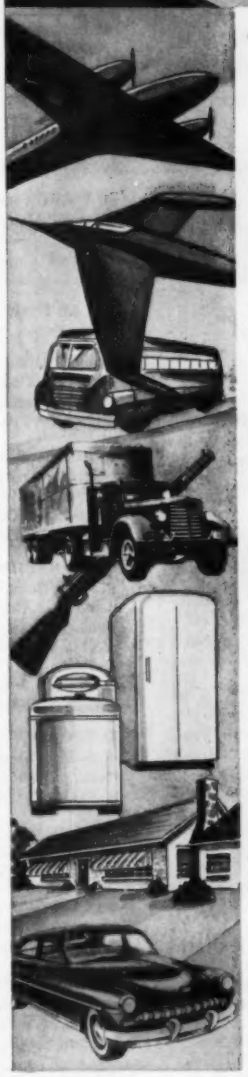

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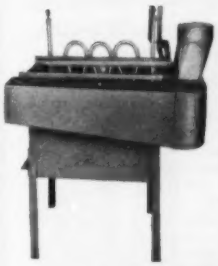

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6TH ANNUAL INSTRUMENT CONFERENCE AND EXHIBIT, sponsored by the Instrument Society of America, in Sam Houston Coliseum, Houston, Texas, on September 10–14.

THE ELECTROCHEMICAL SOCIETY Fall Conference in Statler Hotel, Detroit, Mich., on October 10–13.

3RD ANNUAL METAL SHOW at Michigan State Fair Grounds, Detroit, Mich., on October 15–19.

INTERNATIONAL ASSOCIATION OF ELECTROTYPERS AND STEREOTYPERS 54th Annual Convention in Hotel Kenmore, Boston, Mass., on October 23–25.

24TH INTERNATIONAL CONGRESS FOR INDUSTRIAL CHEMISTRY AND 1ST CHEMICAL EXHIBITION in Paris, France, on November 25–December 1.

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